OPERATING AND SERVICE MANUAL

# MODEL 203A
# VARIABLE PHASE FUNCTION GENERATOR

**SERIALS PREFIXED: 1201J**


P. O. Box 301, Loveland, Colorado, 80537 U. S. A.

PART NO. 00203-99002

01760-7

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## CERTIFICATION

*The Hewlett-Packard Company certifies that this instrument was thoroughly tested and inspected and found to meet its published specifications when it was shipped from the factory. The Hewlett-Packard Company further certifies that its calibration measurements are traceable to the U.S. National Bureau of Standards to the extent allowed by the Bureau's calibration facility.*

## WARRANTY AND ASSISTANCE

All Hewlett-Packard products are warranted against defects in materials and workmanship. This warranty applies for one year from the date of delivery, or, in the case of certain major components listed in the operating manual, for the specified period. We will repair or replace products which prove to be defective during the warranty period provided they are returned to Hewlett-Packard. No other warranty is expressed or implied. We are not liable for consequential damages.

Service contracts or customer assistance agreements are available for Hewlett-Packard products that require maintenance and repair on-site.

For any assistance, contact your nearest Hewlett-Packard Sales and Service Office. Addresses are provided at the back of this manual.

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SECTION II INSTALLATION

SECTION III OPERATING INFORMATION

SECTION IV PRINCIPLES OF OPERATION

SECTION V MAINTENANCE

SECTION VI REPLACEABLE PARTS

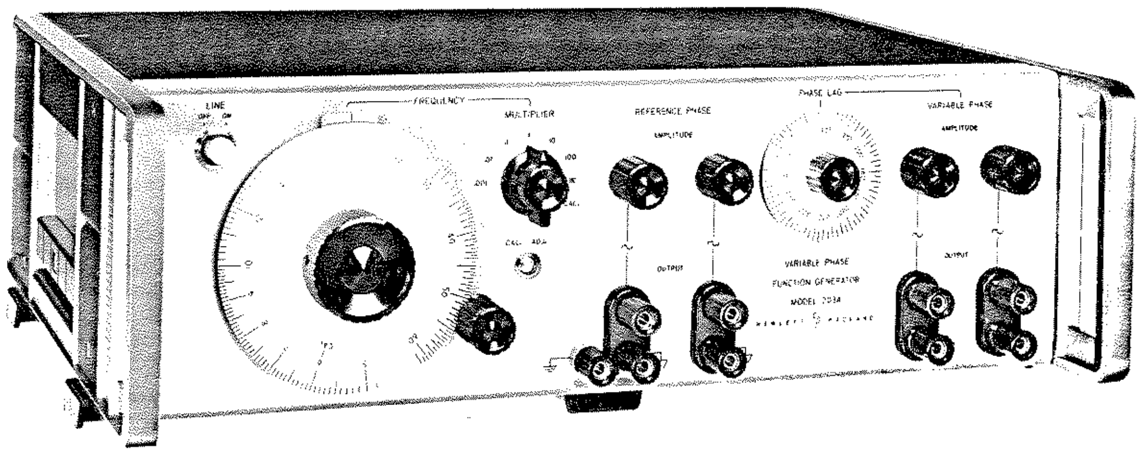


Figure 1-1. Model 203A Variable Phase Function Generator

Table 1-1. Specifications

FREQUENCY RANGE

0.005 Hz to 60 kHz in seven decade ranges. *

DIAL ACCURACY

±1% of reading.

FREQUENCY STABILITY

Within ±1% including warmup drift and line voltage variations of ±10%.

OUTPUT WAVEFORMS

Sine and square waves are available simultaneously. All outputs have common chassis terminal.

MAXIMUM OUTPUT VOLTAGE

30 volts peak-to-peak open circuit for sinusoidal and square waveforms.

OUTPUT POWER

5 volts into 600 ohms (40 mw); at least 40 db continuously adjustable attenuation on all outputs.

*Two lower ranges of 0.0005 Hz (option: 01) and 0.00005 Hz (option: 02) are available on special order.

OUTPUT IMPEDANCE

600 ohms

OUTPUT SYSTEM

Direct coupled output is isolated from ground and may be operated floating up to 500 VDC.

DISTORTION

Total harmonic distortion hum and noise > 64 db below fundamental (< .06%) at maximum output.

FREQUENCY RESPONSE

±1% referenced to 1 kHz.

SQUARE WAVE RESPONSE

Rise and Fall Time: < 200 nsec.
Overshoot: < 5%, at full output.

PHASE RANGE

0 to 360 degrees.
Accuracy: ±5° sine wave.
±10° square wave.

POWER

115 or 230 v ±10%, 50 to 400 Hz.

DIMENSIONS

Cabinet mount, 5 1/4" high x 16 3/4" wide and 11 1/2" deep (133 x 425 x 286 mm).

# SECTION I
# GENERAL INFORMATION

## 1-1. DESCRIPTION.

1-2. The Hewlett-Packard Model 203A Variable Phase Function Generator is a low frequency function generator which provides two sine wave and two square wave test signals at frequencies from 0.005 cps to 60 kc. (Refer to paragraph 1-5, Options Available.)

1-3. The four test signals are provided at the front panel OUTPUT connectors at an open circuit signal level of 30 volts peak-to-peak. The sine wave and square wave test signals provided at the REFERENCE PHASE OUTPUT connectors are fixed in phase and provide a reference phase for the test signals at the VARIABLE PHASE OUTPUT connectors. The variable phase test signals are continuously variable from $0^{\circ}$ to $360^{\circ}$ lag with respect to the phase of the reference test signals. The amplitude of the four output signals can be varied with individual continuously variable 40 db attenuators (AMPLITUDE controls.)

1-4. The output terminals are floating with respect to ground and can be used to supply an output voltage with the common terminal grounded or can be floated up to 500 volts dc above chassis ground. The output impedance for all four test signal outputs is 600 ohms.

## 1-5. OPTIONS AVAILABLE.

1-6. Options 01 and 02 are available to provide two additional frequency ranges to the Model 203A. Option 01 includes one additional Decade Module Board Assembly which extends the lower limit of the frequency range from 0.005 cps to 0.0005 cps. Option 02 includes two additional Decade Module Board Assemblies which extend the lower limit of the frequency range from 0.005 cps to 0.00005 cps. These two options can also be installed as a field modification (see Section VI for stock number of Decade Module Board Assemblies).

## 1-7. APPLICATIONS.

1-8. The Model 203A can be used for phase shift measurements, vibration studies, servo applications, medical research, distortion measurements, geophysical problems, subsonic and audio testing.

## 1-9. INSTRUMENT IDENTIFICATION.

1-10. Hewlett-Packard uses a two-section nine character (0000A00000) or eight character (000-00000 or 000A00000) serial number. The first three or four digits (serial prefix) identify a series of instrument; the last five digits identify a particular instrument in that series. A letter placed between the two sections identifies the country where the instrument was manufactured. The serial number appears on a plate located on the rear panel. All correspondence with Hewlett-Packard Sales/Service Offices with regard to an instrument should refer to the complete serial number.

1-11. If the serial prefix does not agree with the serial prefix on the title page of this manual, a "Manual Changes" sheet supplied will describe changes which will adapt this manual to an instrument with a different serial prefix. Technical corrections (if any) to this manual, due to known errors in print, are called Errata and are shown on the change sheet. For information on manual coverage of any hp instrument, contact the nearest hp Sales/Service Office (addresses are listed at the rear of this manual).

# SECTION II
# INSTALLATION

## 2-1. INSPECTION.

2-2. This instrument was carefully inspected both mechanically and electrically before shipment. It should be physically free of mars or scratches and in perfect electrical order upon receipt. To confirm this, the instrument should be inspected for physical damage in transit. Also check for supplied accessories, and test the electrical performance of the instrument using Table 2-1 or the procedure outlined in paragraph 5-3. If there is any apparent damage, file a claim with the carrier and refer to the warranty on the inside front cover of this manual.

## 2-3. POWER REQUIREMENTS.

2-4. The Model 203A will operate from either 115 or 230 vac, 50-400 Hz. The instrument can be easily converted from 115 to 230 volt operation by changing the position of the slide switch, located on rear panel, so that the designation appearing on the switch matches the nominal voltage of the power source.

## 2-5. THREE-CONDUCTOR POWER CABLE.

2-6. To protect operating personnel, the National Electrical Manufacturers' Association (NEMA) recommends that the instrument panel and cabinet be grounded. All Hewlett-Packard instruments are equipped with a three-conductor power cable which, when plugged into an appropriate receptacle, grounds the instrument. The offset pin on the power cable three-prong connector is the ground wire.

2-7. To preserve the protection feature when operating the instrument from a two-contact outlet, use a three-prong to two-prong adapter and connect the green pigtail on the adapter to ground.

## 2-8. INSTALLATION.

2-9. The Model 203A is fully transistorized; therefore no special cooling is required. However, the instrument should not be operated where the ambient temperature exceeds 55°C (131°F).

## 2-10. RACK/BENCH INSTALLATION.

2-11. The Model 203A is initially shipped as a bench type instrument (unless ordered specifically as a rack type) with plastic feet and a tilt stand in place. Conversion to a rack-mounted instrument can be accomplished by using the rack mounting kit and instructions furnished with your instrument.

## 2-12. REPACKAGING FOR SHIPMENT.

2-13. The following is a general guide for repacking an instrument for shipment. If you have any questions, contact your local hp Sales and Service Office (see lists in Appendix for location).

a. Place instrument in original container if it is available. If original container is not available, one can be purchased from your nearest hp Sales and Service Office.

Note

> If instrument is to be shipped to Hewlett-Packard for service or repair, attach to the instrument a tag identifying the owner and indicate the service or repair to be accomplished; include the model number and full serial number of instrument. In any correspondence, identify the instrument by model number and serial number prefix.

If original container is not used,

b. Wrap instrument in heavy paper or plastic before placing in an inner container.

c. Use plenty of packing material around all sides of instrument and protect panel face with cardboard strips.

d. Place instrument and inner container in a heavy carton or wooden box and seal with strong tape or metal bands.

e. Mark shipping container with "Delicate Instrument," "Fragile" etc.

Table 2-1. Checks for Incoming Inspection (Specifications)

| Check | Test Equipment | 203A Control Settings | Output Connector | Specifications |
|---|---|---|---|---|
| Maximum Output Voltage | Oscilloscope | Amplitudes fully clockwise<br>FREQUENCY 1 kc | REFERENCE PHASE ∿<br>REFERENCE PHASE ⊓⊔<br>VARIABLE PHASE ∿<br>VARIABLE PHASE ⊓⊔ | Open Circuit:<br>30 v PTP<br>600 Ω load:<br>∿ >5 v RMS<br>⊓⊔ 15 v PTP |
| Frequency Range | Oscilloscope DC Coupled | All ranges at low end and high end of dial | Any one output | 005 cps to 60 kc (output at all points) |
| Square Wave Response<br>Rise Time<br>Fall Time<br>Ampl. of Overshoot<br>Rise Time<br>Fall Time<br>Ampl. of Overshoot | Oscilloscope DC Coupled | FREQUENCY 60 kc | REFERENCE PHASE ⊓⊔<br><br><br>VARIABLE PHASE ⊓⊔ | <200 nsec<br><200 nsec<br><. 75 volts (5%)<br><200 nsec<br><200 nsec<br><. 75 volts (5%) |
| Dial Accuracy | Electronic Counter (Use period for low frequencies) | FREQUENCY-All ranges at least two points on the dial | Any one output | ±1% of reading |
| Frequency Response | Oscilloscope DC Coupled | REFERENCE: 1 kc<br>Check all ranges at least three points on the dial | REFERENCE PHASE ∿<br>VARIABLE PHASE ∿ | ±1% referenced to 1 kc |
| Distortion | Distortion Analyzer | All ranges at least one point on dial | REFERENCE PHASE ∿<br>VARIABLE PHASE ∿<br>(Rotate phase dial to achieve worst case) | > - 64 db<br>> - 64 db |

# SECTION III
# OPERATION

## 3-1. INTRODUCTION.

3-2. The Model 203A generates two sine wave and two square wave signals which are available simultaneously at the front panel OUTPUT connectors. The output signal frequency is determined by the position of the FREQUENCY dial and FREQUENCY MULTIPLIER switch. By the use of the PHASE LAG control, the phase of the VARIABLE PHASE OUTPUT signals (one sine wave and one square wave) can be continuously adjusted from $0^{\circ}$ to $360^{\circ}$ with respect to the REFERENCE PHASE OUTPUT signals. The OUTPUT terminals provide an open-circuit signal level of 30 volts peak-to-peak. The individual AMPLITUDE controls provide 40 db of attenuation for each output signal. The CAL ADJ control provides a means of calibrating the FREQUENCY dial with the line frequency.

## 3-3. CONTROLS AND INDICATORS.

3-4. Figure 3-1 describes the function of all front panel controls, connectors, and indicators. The description of each component is keyed to a drawing which is included within the figure.

## 3-5. OPERATING INSTRUCTIONS.

3-6. Figure 3-2 contains operating procedures keyed to a drawing included in the figure. Refer to figure 3-1 for the function of each control and paragraph 2-3 for setting the line voltage switch.

## 3-7. CALIBRATION FOR 60 CYCLE LINE FREQUENCY.

3-8. A quick procedure for checking the calibration of the frequency dial is as follows:

a. Set the FREQUENCY dial to 6 (CAL).

b. Set the FREQUENCY MULTIPLIER to CAL. (The pilot light will flicker.)

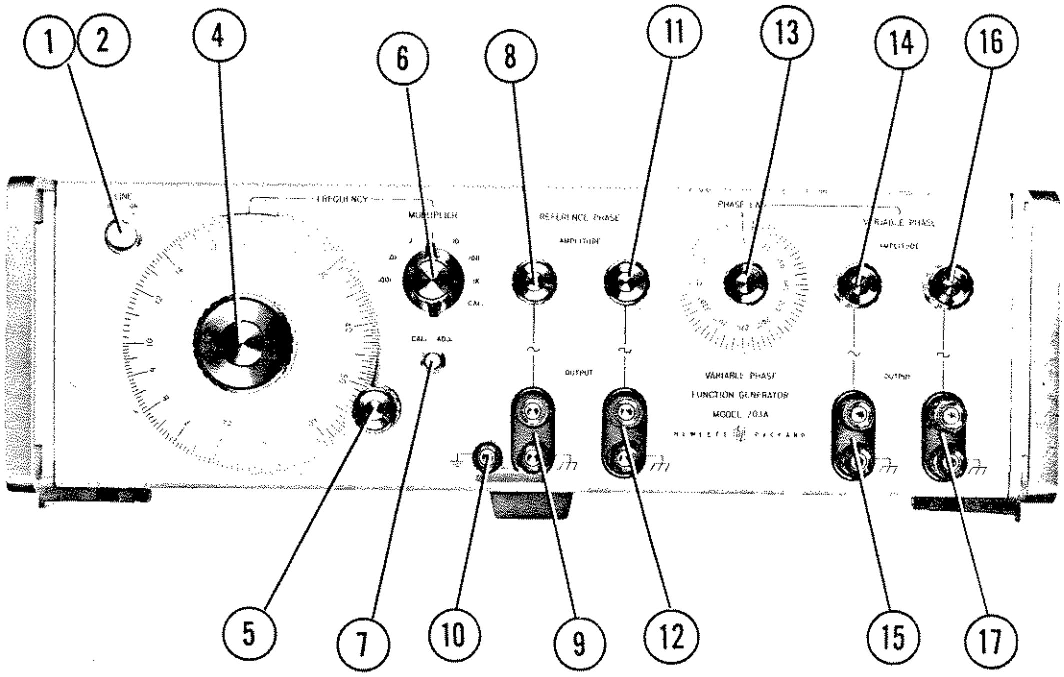
c. Adjust the CAL ADJ for minimum rate of flicker.

Note

If the flicker rate is not close to minimum, use the Frequency Calibration check paragraph 5-5.
When the FREQUENCY MULTIPLIER switch is in the CAL position, there is no output at the REFERENCE PHASE ⊓⊔ OUTPUT connector.

## 3-9. CALIBRATION FOR LINE FREQUENCIES OTHER THAN 60 CYCLES.

3-10. For line frequencies other than 60 cps the FREQUENCY dial is set to 1/10 of the line frequency (40 to 400 cps line frequency). Again the calibration is made with the front panel CAL ADJ control, which is adjusted for a minimum flicker rate of the pilot lamp. For line frequencies above 600 cps the FREQUENCY dial is set to 1/30 of the line frequency (33.3 for a 1000 cps line frequency). At the higher line frequencies the flicker intensity decreases and the CAL ADJ control sensitivity increases.




1. Push ON/OFF power switch.

2. Pilot light and calibration indicator.

3. Not Assigned.

4. FREQUENCY selector dial, indicates cps times the FREQUENCY MULTIPLIER switch setting.

5. Vernier, provides fine frequency adjustment.

6. FREQUENCY MULTIPLIER, selects frequency range and in the CAL position sets up the 203A for frequency dial calibration (see paragraph 3-7).

7. CAL ADJ, adjust frequency dial calibration (see paragraph 3-7).

8. REFERENCE PHASE channel sine wave AMPLITUDE control, provides continuous adjustable attenuation of up to 40 db.

9. REFERENCE PHASE channel sine wave output terminals, provide a nominal 30 volts peak-to-peak from a 600 ohm source impedance.

10. Earth Ground.

11. REFERENCE PHASE channel square wave AMPLITUDE control, provides continuously adjustable attenuation of up to 40 db.

12. REFERENCE PHASE channel square wave output terminals, provide a nominal 30 volts peak-to-peak from a 600 ohm source impedance.

13. PHASE LAG control, provides continuously adjustable phase lag from $0^\circ$ through $360^\circ$ of the variable phase channel with respect to the reference phase channel.

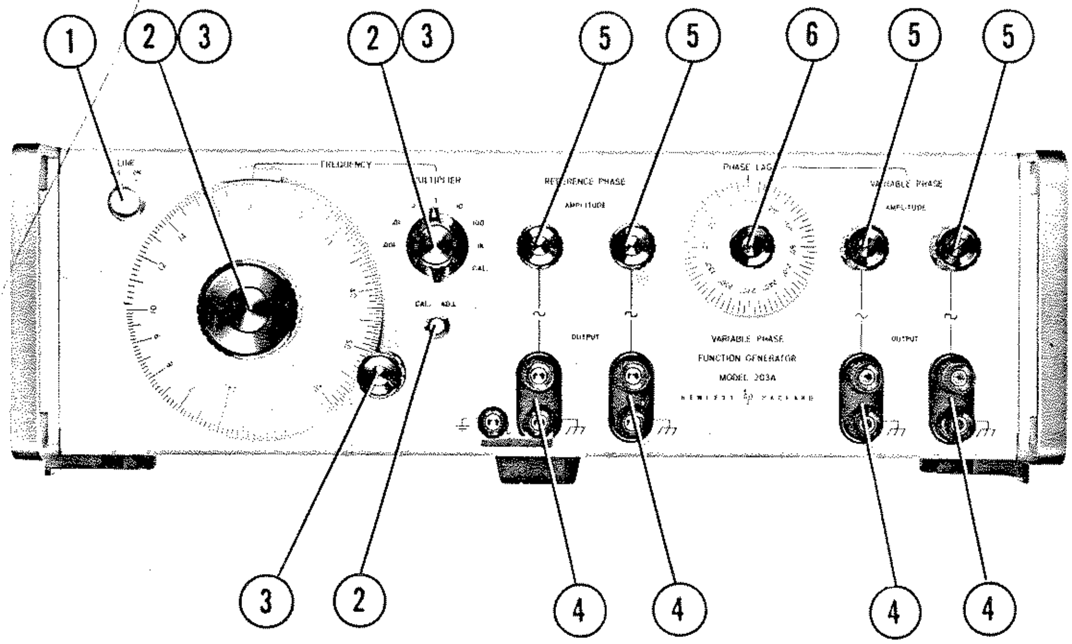
14. VARIABLE PHASE channel sine wave AMPLITUDE control, provides continuously adjustable attenuation of up to 40 db.

15. VARIABLE PHASE channel sine wave output terminals, provide a nominal 30 volts peak-to-peak from a 600 ohm source impedance.

16. VARIABLE PHASE channel square wave AMPLITUDE control, provides continuously adjustable attenuation of up to 40 db.

17. VARIABLE PHASE channel square wave output terminals, provide a nominal 30 volts peak-to-peak from a 600 ohm source impedance.

Figure 3-1. Front Panel Description



1. Push LINE switch ON, pilot lamp glows.

2. The Frequency Calibration may be compared to line frequency as described in paragraph 3-7.

3. Set FREQUENCY dial and MULTIPLIER switch to desired output frequency. Use vernier control on FREQUENCY dial for fine-frequency adjustments.

4. Select the desired test signal(s) and connect load to OUTPUT connector(s).

5. Set AMPLITUDE control(s) for desired signal level.

6. Set PHASE LAG control for desired degree of phase lag of the VARIABLE PHASE test signal(s) with respect to the REFERENCE PHASE test signal(s).

Figure 3-2. Operating Instructions

# SECTION IV
# PRINCIPLES OF OPERATION

## 4-1. OVERALL DESCRIPTION.

4-2. This section describes how the Model 203A Variable Phase Function Generator operates. The block diagram, figure 4-2, shows the main sections and the signal flow within the Model 203A.

4-3. The Model 203A is a beat-frequency oscillator which, by mixing two high-frequency signals, generates signals in the frequency range of 0.005 cps to 60 kc (refer to paragraph 1-5 for options). One of the high-frequency signals is a fixed frequency; the other is variable. The Model 203A has two signal channels, REFERENCE PHASE and VARIABLE PHASE, each of which produces a sine-wave signal and a square-wave signal. The two channels are electrically similar except that the VARIABLE PHASE channel contains a continuously adjustable phase-shifting circuit which changes the phase relationship of the VARIABLE PHASE OUTPUT with respect to the REFERENCE PHASE OUTPUT. The four signals (two reference phase and two variable phase) are available simultaneously at the OUTPUT connectors.

4-4. The fixed frequency signal, which is generated by a crystal oscillator, is applied to both channels and routed to a modulator through an RF Amplifier within each channel. The variable frequency signal is applied directly to the modulator of each channel. The frequency of the variable frequency signal is controlled by the position of the FREQUENCY dial and the setting of the FREQUENCY MULTIPLIER switch. These two signals are mixed in the modulator and the difference in frequency between the two signals is the output frequency of the Model 203A.

## 4-5. CRYSTAL OSCILLATOR AND DIVIDER ASSEMBLY (A1).

4-6. Assembly A1 consists of a crystal controlled oscillator and a 9:1 frequency divider. Refer to the schematic diagram, figure 5-10, for circuit details.

### 4-7. CRYSTAL OSCILLATOR.

4-8. The oscillator (A1Y1 and A1Q1) is a crystal controlled grounded base Colpitts oscillator. The 5 Mc output is applied through buffer amplifier A1Q2, for isolation, to the base of the 9:1 frequency divider.

### 4-9. 9:1 FREQUENCY DIVIDER.

4-10. The 9:1 divider consists of a divider A1Q3 and a tank circuit which consists of A1C8, A1C9, A1C11, and A1L2. The divider is basically a class C grounded base Colpitts oscillator.

4-11. Two things occur during each cycle of the divider operation. One is amplitude modulation of the signal applied to the base of A1Q3, and the second is a mixing action within A1Q3. Each function occurs at a different time during each cycle of oscillation and together tend to synchronize A1Q3 with a sub-multiple frequency of the frequency applied to the base of the divider.

4-12. Divider A1Q3 operates in the region of voltage saturation for a portion of each cycle. During the saturation period, the impedance between the base and collector of A1Q3 becomes very low; for the rest of cycle the impedance between the base and collector is relatively high. The variation in impedance between base and collector of A1Q3 results in amplitude modulation (about 10%) of the signal on the base of the divider. This amplitude modulation creates sidebands at the 8th and 10th harmonic of the divider oscillating frequency.

4-13. The signal applied to the base of A1Q3 is about 4.995 Mc which is generated by the crystal oscillator circuit. The tank circuit of the 9:1 divider is tuned so that A1Q3 is oscillating at the 9th sub-multiple frequency of 4.995 Mc (555 kc).

4-14. The mixing process within A1Q3 occurs at the time during each cycle when the divider just starts to conduct. During this short time, the 8th and 10th harmonic of the 555 kc signal are mixed with the 9th harmonic resulting in a frequency component at 555 kc which influences the oscillations of A1Q3. The result is that A1Q3 stays synchronized to the 9th sub-harmonic of 4.995 Mc.

4-15. The pi type tank circuit filters out harmonic frequencies which may be present at the collector of A1Q3. A buffer amplifier A1Q4 provides further filtering, isolation, and power gain. The output of the 9:1 divider is a 555 kc signal and is coupled by A1T2 to A2Q1 and A2Q2 (see figures 5-10 and 5-12).

## 4-16. VARIABLE PHASE SHIFTER ASSEMBLY.

4-17. The variable phase shifter assembly A25 (figure 5-12) is a goniometer consisting of two stator windings, a rotor winding, and associated circuits. The goniometer requires two 555 kc input signals; one from A2Q2 to one of the stator windings, and the other from A2Q1 and the 90° phase shift network to the other stator winding. The output phase corresponds to the angle of the rotor winding (PHASE LAG control). The phase can be continuously adjusted from 0° through 360° with respect to the reference signal while maintaining a constant amplitude. The adjustable phase shifter output is applied to the RF amplifier assembly A2 (figure 5-12).

## 4-18. RF AMPLIFIERS (A2).

4-19. The RF amplifier assembly A2 consists of two RF amplifiers; A2Q3, A2Q4, and A2Q5 for the reference phase channel and A2Q6 through A2Q9 for

the variable phase channel. Refer to the schematic diagram (figure 5-12) for circuit details.

4-20. VARIABLE PHASE CHANNEL RF AMPLIFIER.

4-21. The signal from the variable phase shifter is amplified by A2Q6, then applied to the base of A2Q7. A2Q7 and A2Q8 act as an over-driven amplifier which amplifies and clips the signal applied to the base of A2Q7; this operation produces a square wave of current at the collector of A2Q8. The zero crossing of the square wave of current coincides with the zero crossing of the sine wave signal applied to the base of A2Q7 so that the phase of the applied signal is preserved. A tuned network, formed by A2C24, A2C25, A2C29, A2C30, A2L7, and A2T2 filters the 555 kc square-current waveform to a nearly pure sine wave.

4-22. The output of the RF amplifier circuit, which is taken across A2C30, is maintained at a constant amplitude by the level controlling circuit. If the output should increase, the voltage at A2C27 increases, resulting in a voltage increase at the base of A2Q9. This increase is applied to the bases of A2Q7 and A2Q8 which then conduct less average current. When A2Q8 conducts less, the signal at its collector dedecreases and the output voltage decreases, opposing the original change. The result is that the amplitude of the output remains nearly constant despite variations in the amplitude of the input signal. The output signal is then applied to A3T4 in the modulator assembly A3 (figure 5-16).

4-23. REFERENCE PHASE CHANNEL RF AMPLIFIER.

4-24. The signal present at the emitter of A2Q2 is applied to the reference phase channel RF amplifier section, A2Q3 through A2Q5. This stage operates the same as the variable phase channel RF amplifier described in paragraph 4-20. The output signal is then applied to A3T3 in the modulator assembly A3 (figure 5-16).

## 4-25. VARIABLE FREQUENCY OSCILLATOR (A10).

4-26. The variable frequency oscillator assembly A10 generates a signal that is variable from 495 kc to 550 kc by rotation of the front panel FREQUENCY dial. The FREQUENCY dial is calibrated so that with the dial set at 5 the VFO is oscillating at 550 kc and with the dial set at 60 the VFO is oscillating at 495 kc. The output signal from the variable frequency oscillator is applied to the 1 K position of the MULTIPLIER (frequency range) switch and also to the 1st decade module. Refer to the schematic diagram, figure 5-14, for circuit details.

## 4-27. DECADE MODULES (A11-A16).

4-28. The six decade module assemblies A11 thru A16 each consist of a mixer, a bandpass filter, and a 10:1 divider. These decades produce a band of high frequency signals that are mixed in the modulators (A3) with the 555 kc fixed frequency signal from the RF amplifiers to produce a signal in the 0.005 cps to 60 kc range (refer to paragraph 1-5 for options). Refer to the schematic diagram, figure 5-14 and figure 4-1 for circuit details.

4-29. DECADE MODULE (A11).

4-30. The 4.995 Mc signal from the crystal oscillator is applied to the emitter of A11Q1 isolation stage, and subsequently appears across the primary of A11T1. The signal from A11T1 is applied to a suppressed carrier, balanced modulator. The 495 kc VFO signal (assume

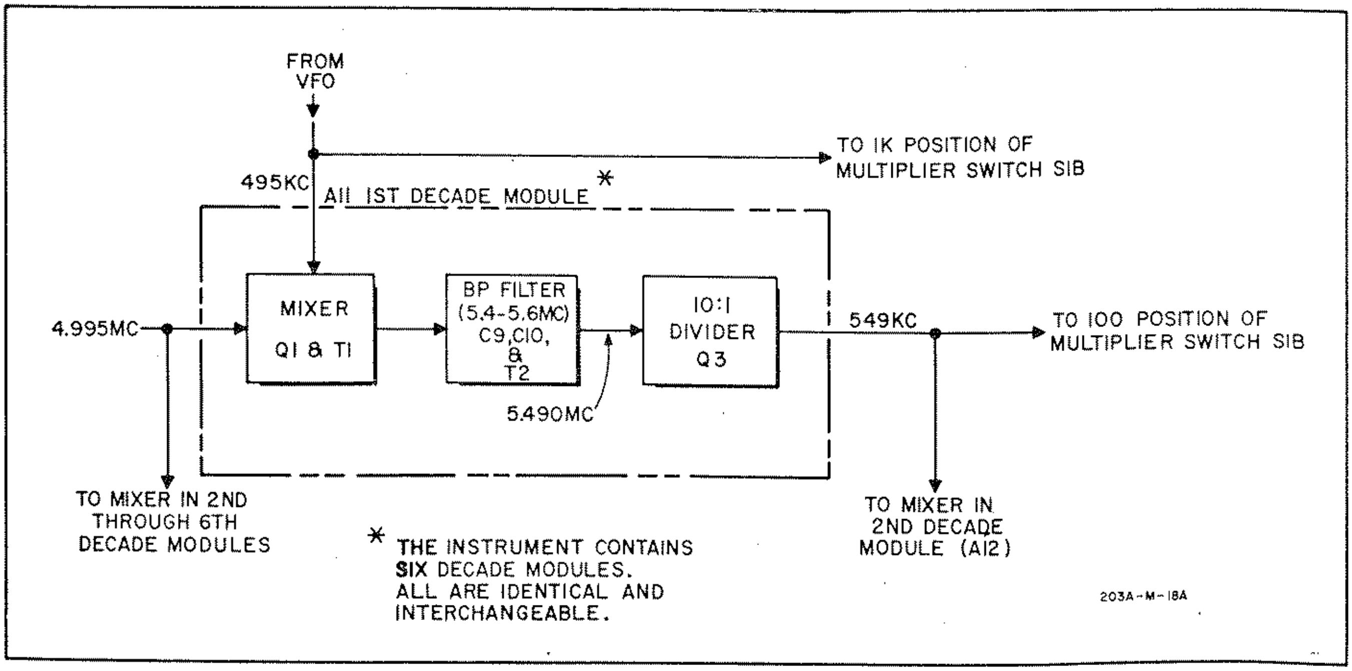



Figure 4-1. Circuit Details

that the FREQUENCY dial is at 60 and the VFO signal is 495 kc) is applied to the other input of the balanced modulator. Both signals are mixed, and the sum and difference of these two frequencies will appear at the output. The signal from the balanced modulator is passed through an LC filter network which is tuned for a band-pass of from 5.4 Mc to 5.6 Mc, which only allows the sum frequency to pass on to the 10:1 divider A11Q3. The 10:1 divider is similar to the 9:1 divider described in paragraph 4-9; the main difference being that the tuned tank circuit in the 10:1 divider is adjusted so that the stage provides an exact 10:1 division of the input frequency. The resultant frequency is fed to the 100 position of the FREQUENCY MULTIPLIER switch and to the mixer in the second decade module A12.

4-31. DECADE MODULES, A12 THROUGH A16.

4-32. The action within the succeeding decade modules is the same as that described for the first decade module A11. The output of each module is applied to a position of the FREQUENCY MULTIPLIER switch and to the mixer in the following decade module. Thus a set of variable frequency signals are produced and when mixed with the constant high-frequency signal in the modulator (A3) a beat frequency is produced. The beat frequency is decreased by a factor of 10 for each lower range of the FREQUENCY MULTIPLIER switch.

## 4-33. MODULATOR ASSEMBLY, A3.

4-34. The Modulator assembly A3 consists of a modulator drive amplifier and two balanced switching type modulators; one for the REFERENCE PHASE channel, and the other for the VARIABLE PHASE channel. Refer to the schematic diagram, figure 5-16, for details.

4-35. MODULATOR DRIVER AMPLIFIER.

4-36. The frequency selected by the FREQUENCY dial and the FREQUENCY MULTIPLIER is applied to the input of the modulator driver amplifier A3Q1 where it is amplified and applied to A3Q2 and A3Q3. A3Q2 and A3Q3 act as an over driven amplifier which amplifies and clips the signal applied to the base of A3Q2. This operation produces a square wave output at the collector of A3Q3 which is applied to the modulator section as a switching signal.

4-37. REFERENCE PHASE CHANNEL MODULATOR.

4-38. The modulator driving signal (VFO) and decade output) is applied to the bases of the switching transistors (A3Q5 thru A3Q8). The fixed frequency, a 555 kc sine wave, is applied through series resistors to the emitters of the switching transistors. The output at the collectors is sine wave of the sum and difference frequencies. This signal is applied to the low pass filter assembly A4 (figure 5-18). The filter passes only the difference frequency, the output is a sine wave having a frequency that is between 0.005 cps and 60 kc depending on the position of the FREQUENCY MULTIPLIER switch and the FREQUENCY dial setting (refer to paragraph 1-5 for Options). The output signal is applied to the dc amplifier A6.

4-39. A dc reference voltage is derived by summing the signals at the collectors of A3Q5 and A3Q6. This dc reference voltage is used as a reference voltage for the differential amplifier in the dc amplifier assembly A6.

4-40. VARIABLE PHASE CHANNEL MODULATOR.

4-41. The variable phase channel modulator operates the same as the reference phase channel described in paragraph 4-37, except that the output is applied to the Low Pass Filter A5 and then to the dc amplifier A7.

## 4-42. DC AMPLIFIER ASSEMBLIES A6 AND A7.

4-43. After passing through the low pass filter the signal is fed to the direct coupled amplifiers; A6 for the reference phase channel, and A7 for the variable phase channel. Refer to the schematic diagrams figures 5-18 and 5-20 for circuit details.

4-44. REFERENCE PHASE CHANNEL DC AMPLIFIER ASSEMBLY.

4-45. The dc amplifier uses a differential amplifier for the input stage. The dc reference voltage from the modulator section is used as the reference input for the differential amplifier. This configuration minimizes any tendency of dc drift due to power supply temperature variations. The dc amplifier circuit uses negative feedback to provide for low distortion amplification. The output is applied to a bridged-T type attenuator and the square wave generator A8.

4-46. VARIABLE PHASE CHANNEL DC AMPLIFIER ASSEMBLY.

4-47. The variable phase channel dc amplifier operates the same as the reference phase channel described in paragraph 4-44, except that the output is applied to bridged-T type attenuator and the square wave generator, A9.

## 4-48. SQUARE WAVE AMPLIFIER ASSEMBLIES A8 AND A9.

4-49. The output sine wave from the dc amplifier is applied to a square wave generator section, A8, for the REFERENCE PHASE channel, and A9 for the VARIABLE PHASE channel. Refer to the schematic diagrams, figures 5-18 and 5-20, for circuit details.

4-50. REFERENCE PHASE CHANNEL SQUARE WAVE GENERATOR.

4-51. The sine wave from the dc amplifier is amplified by A8Q1 then applied to the base of A8Q2. A8Q2 and A8Q3 act as an over driven amplifier which ampli-

fies and clips the signal applied to the base of A8Q2, and produces a square wave at the collector of A8Q3. This square wave is applied to A8Q4 and A8Q5 which form a Schmitt trigger circuit. The Schmitt trigger is a regenerative circuit which changes states abruptly when the input signal crosses a specific dc triggering level. The output from this stage is a square wave having a rise time of less than 0.2 microsecond with the same frequency and phase as the sine wave signal applied to the circuit. The output is applied to a bridged-T attenuator.

## 4-52. VARIABLE PHASE CHANNEL SQUARE WAVE GENERATOR.

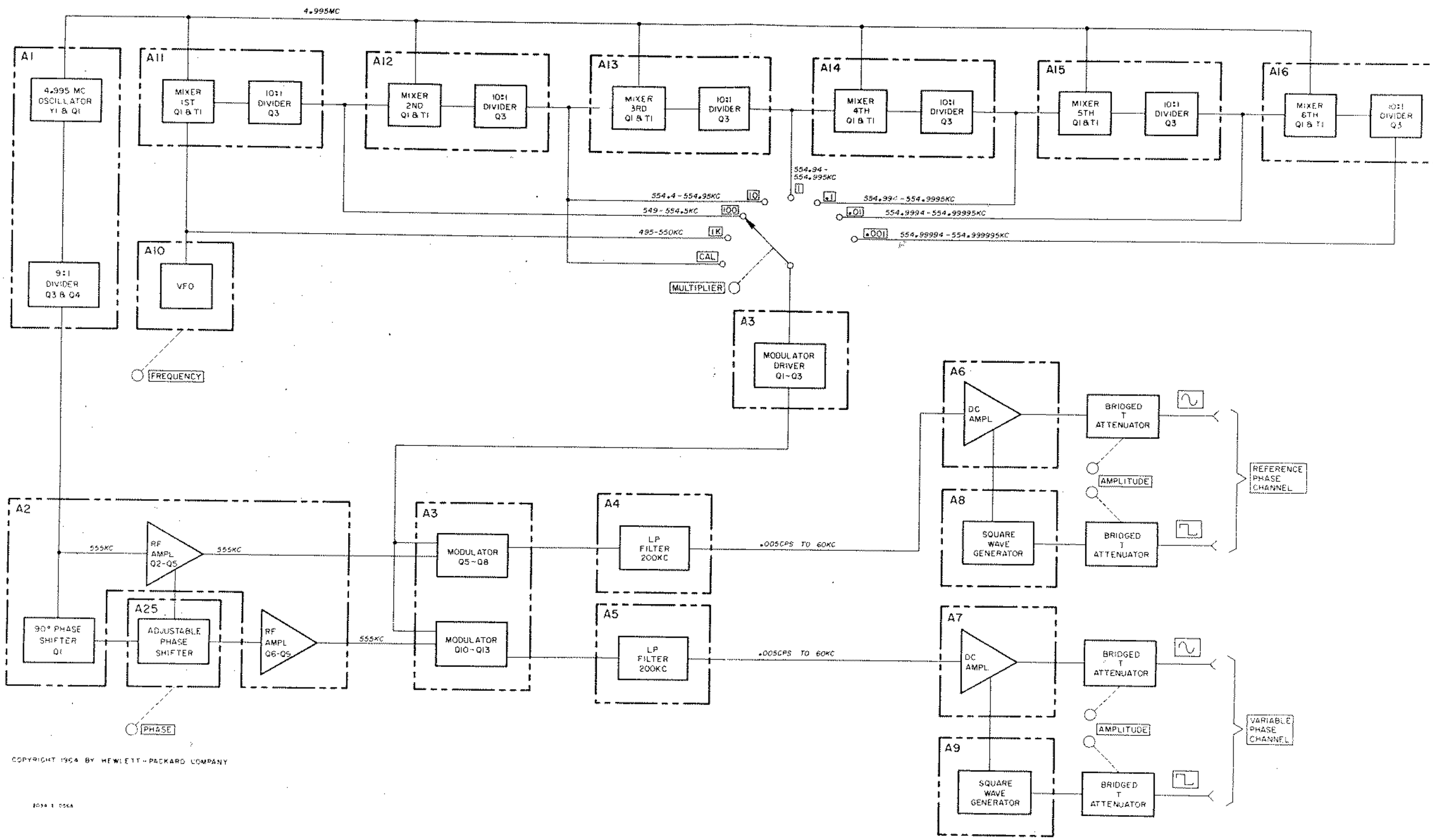
4-53. The variable phase channel square wave generator operates the same as the reference phase channel described in paragraph 4-50.

## 4-54. DC POWER SUPPLY A21, A22.

4-55. The dc power supply provides regulated +15, -15, and -24.5 volts and unregulated +35 volts.

## 4-56. CALIBRATION FEATURE.

4-57. A quick check for calibration of the frequency dial is a comparison between instrument and line frequency. The FREQUENCY dial is set to 6 (CAL) and the FREQUENCY MULTIPLIER is set to the CAL position. Through S1BR a 60 cycle output from A11 is applied to the pilot light which will mix with the 60 cycle line frequency. The pilot light will flicker at the difference or beat rate. This rate may be adjusted to minimum by the CAL ADJ control which slightly affects the VFO frequency. At a minimum rate of flicker the instrument's 60 cycle frequency will be most nearly like the 60 cycle line frequency. For checking the exact frequencies throughout the ranges see paragraph 5-5 Frequency Dial Calibration.






01760-2

Figure 4-2. Block Diagram

# SECTION V
# MAINTENANCE

## 5-1. REQUIRED TEST EQUIPMENT.

5-2. Recommended test equipment for trouble-shooting and performance checking is listed in table 5-1. Test instruments other than those listed may be used if their specifications equal or exceed the required characteristics.

## 5-3. PERFORMANCE CHECKS.

5-4. Use the following front panel procedures to verify proper operation of the ⓗⓟ Model 203A. The Model 203A and test equipment should be operated at 115/230 vac unless otherwise specified. If the Model 203A is not within specifications at any point in this procedure, refer to paragraph 5-12, ADJUSTMENTS.

5-5. FREQUENCY DIAL CALIBRATION.

a. Push Model 203A LINE switch ON. Pilot light should glow.

b. Set FREQUENCY dial to 6 (CAL); MULTIPLIER switch to CAL.

c. Adjust front panel CAL ADJ until visual zero beat is obtained on front panel pilot light. This occurs when flashing rate of the pilot light approaches zero.

d. Connect Model 203A as shown in figure 5-1.

e. Rotate FREQUENCY dial and observe Electronic Counter readings at points shown in table 5-2; counter readings should be within limits shown. At frequencies below 100 cps use period measurements.

Table 5-1. Required Test Equipment

| Instrument Type | Required Characteristics | Use | Recommended Model |
|---|---|---|---|
| DC Voltmeter | Voltage Range: 0 - 50 volts<br>Input Impedance > 10 M ohms<br>Accuracy: ±1% | Performance Checks | ⓗⓟ Model 412A |
| AC Voltmeter | Voltage Range: 1 mv - 100 v<br>Freq. Response: to 600 kc<br>Accuracy: ±2% | Performance Checks | ⓗⓟ Model 403B<br>or<br>ⓗⓟ Model 400D/H/L |
| Oscilloscope | Bandwidth: DC - 5 mc | Waveform Checking | ⓗⓟ Model 175A with<br>ⓗⓟ Model 1780A Horizontal Plug-In<br>ⓗⓟ Model 1750A Vertical Plug-In<br>ⓗⓟ Model 10003A 10:1 Probe |
| Frequency Counter | Range: 0.005 cps - 60 kc | Performance Checks | ⓗⓟ Model 523C |
| Distortion Analyzer | Range: 5 cps to 60 kc | Performance Checks | ⓗⓟ Model 331A |
| Variable Transformer | Output Voltage: 103 - 127 vac | Performance Checks | Powerstat |
| 6 pin printed board extender | | Troubleshooting<br>Adjustment | ⓗⓟ #5060-0651 |
| 15 pin printed board extender | | Troubleshooting<br>Adjustment | ⓗⓟ #5060-0047 |
| Thermal 50Ω Converter | .45 VAC input, 7.0 mv<br>DC output ±0.2%<br>5 cps - 60 kc | Frequency Response | ⓗⓟ Model 11051A |
| Nylon Tuning Wand | | Adjustment | ⓗⓟ #8730-0016 |
| Soldering Iron and Tips | 50 watts<br>Tip Temperature: 800°F<br>Tip Size: 1/16" - 3/32"<br>Round Tip Dia: 3/4" | Troubleshooting<br>Repair | Ungar No. 776 handle with Ungar No. PL333 tiplet and Ungar No. 885 3/4" cups tip |

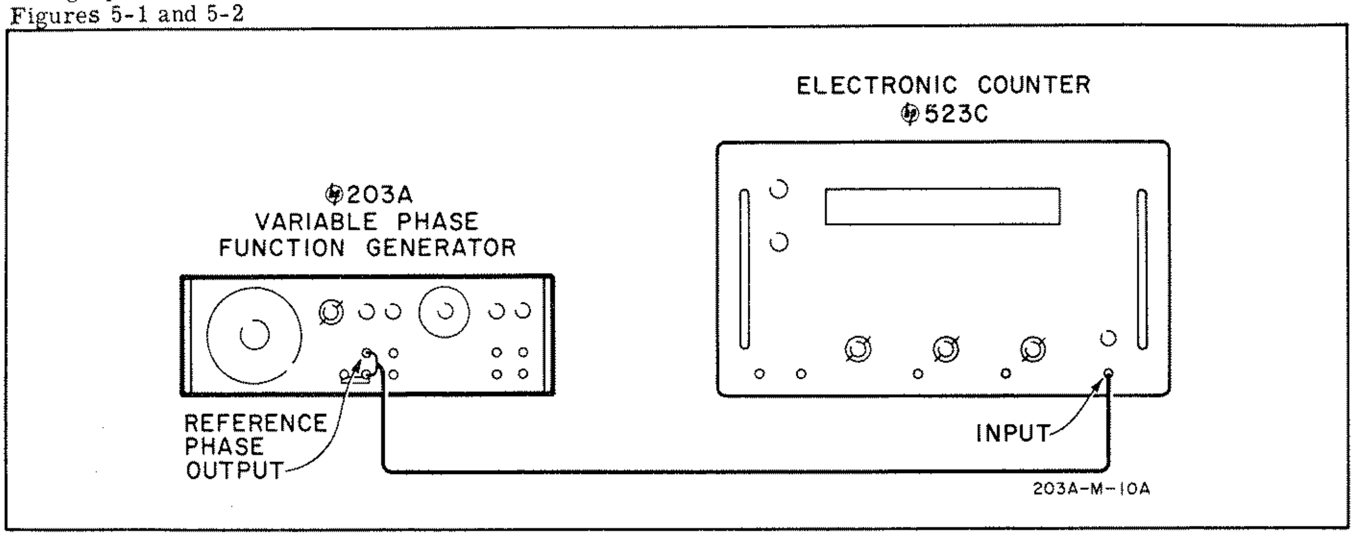



Figure 5-1. Frequency Dial Calibration

This table can be used at all MULTIPLIER switch settings by changing the decimal point of the given counter reading.

## 5-6. FREQUENCY RESPONSE.

a. Set Model 203A controls as follows:

| | |
|---|---|
| FREQUENCY | 10 |
| MULTIPLIER | 100 |

**CAUTION**

INSURE THAT ALL FOUR AMPLITUDE CONTROLS ARE FULLY COUNTERCLOCKWISE TO AVOID DAMAGE TO THE THERMAL CONVERTER.

b. Connect Model 203A as shown in figure 5-2, using very short leads between the Model 203A and Thermal Converter.

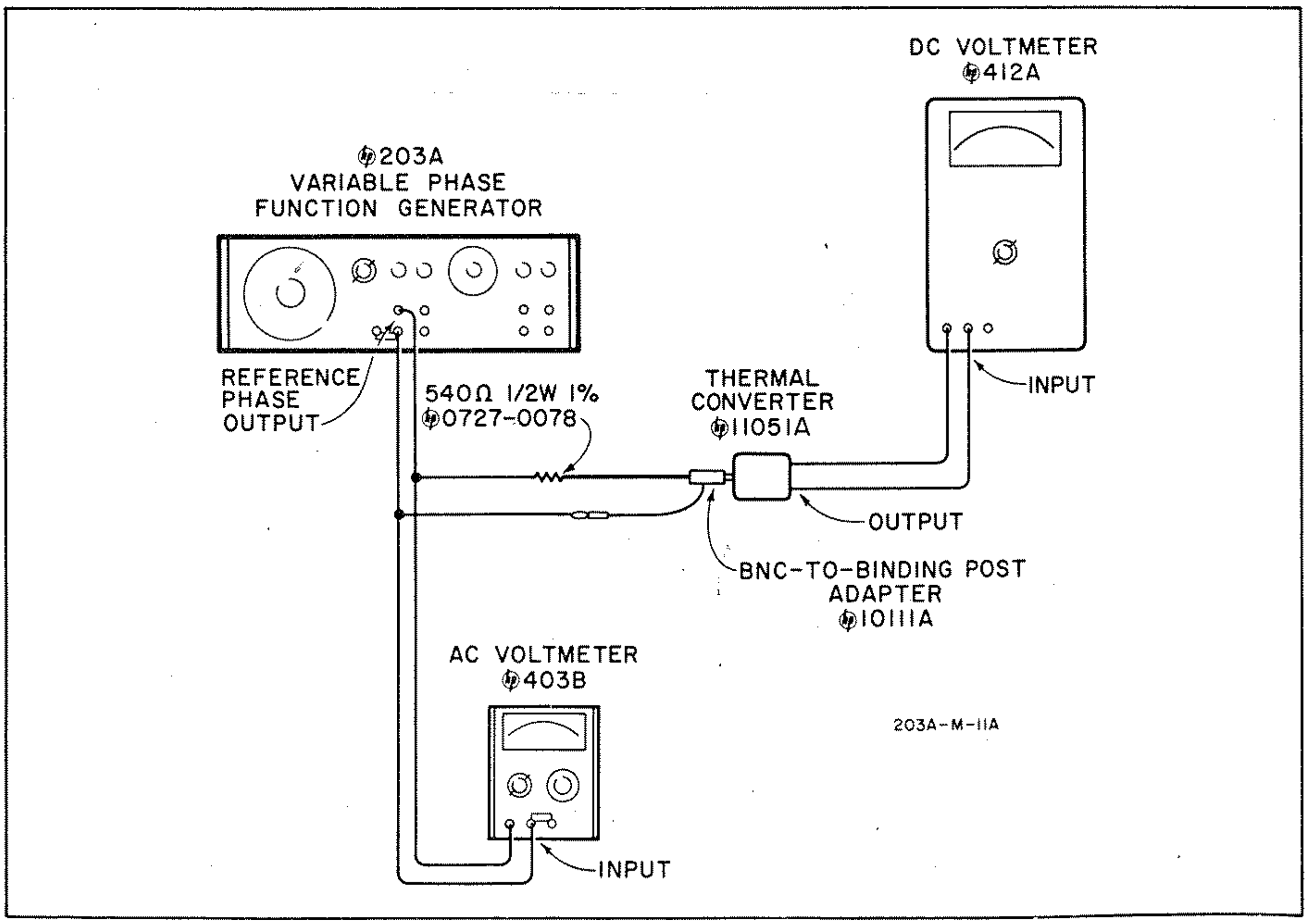



Figure 5-2. Frequency Response

Table 5-2. Frequency Dial Calibration

| FREQUENCY Dial | Counter Period Measurement (below 100 cps) | | Counter Frequency Measurement (above 100 cps) | |
|---|---|---|---|---|
| | Minimum | Maximum | Minimum | Maximum |
| 5 | 1980 | 2020 | 495 | 505 |
| 6 | 1650 | 1684 | 594 | 606 |
| 7 | 1415 | 1443 | 693 | 707 |
| 8 | 1238 | 1263 | 793 | 808 |
| 9 | 1100 | 1122 | 891 | 909 |
| 10 | 990 | 1010 | 990 | 1010 |
| 12 | 825 | 841 | 1188 | 1212 |
| 14 | 707 | 721 | 1386 | 1414 |
| 17 | 582 | 594 | 1683 | 1717 |
| 20 | 495 | 505 | 1980 | 2020 |
| 25 | 396 | 404 | 2475 | 2525 |
| 30 | 330 | 336 | 2970 | 3030 |
| 40 | 247 | 253 | 3960 | 4040 |
| 50 | 198 | 202 | 4950 | 5050 |
| 60 | 165 | 169 | 5940 | 6060 |

**CAUTION**

DO NOT EXCEED 7.5 MILLIVOLT OUTPUT AS THE THERMAL CONVERTER IS VERY EASILY DAMAGED BY EXCESSIVE INPUT VOLTAGE.

c. Set REFERENCE PHASE ~ OUTPUT for a reading of 4.9 vac on the ac voltmeter.

d. Disconnect AC Voltmeter.

e. Slowly adjust REFERENCE PHASE ~ OUTPUT for dc voltmeter reading of 7.0 millivolts.

f. Vary Model 203A FREQUENCY from 5 cps to 60 kc.

g. DC voltmeter reading should stay between 6.86 and 7.14 millivolts.

h. Repeat steps b thru g for VARIABLE PHASE OUTPUT.

j. Disconnect resistor, thermal converter and dc voltmeter.

5-7. SINE WAVE CHECK.

a. Connect Model 203A as shown in figure 5-3.

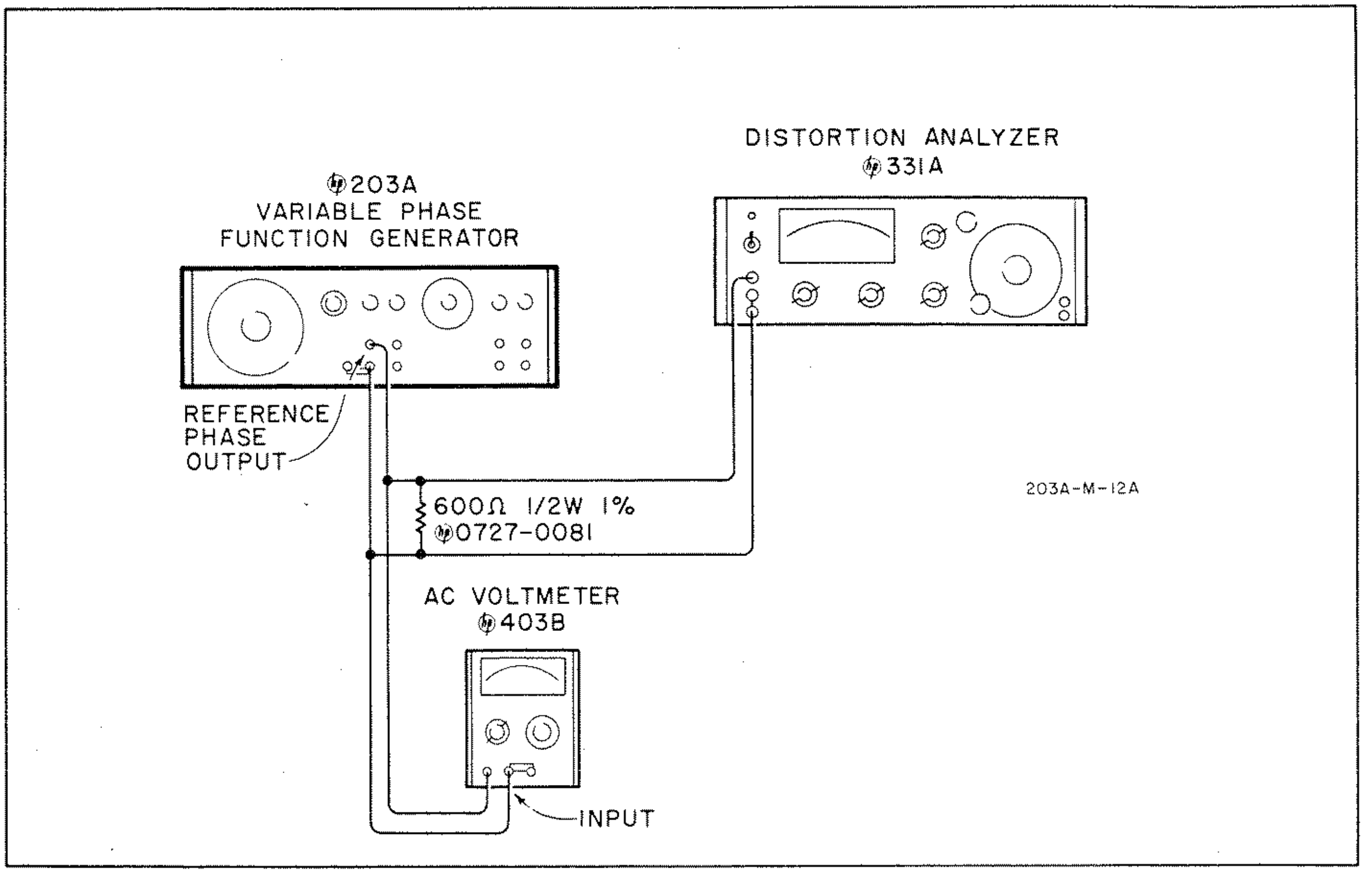



Figure 5-3. Sine Wave Check

b. Set Model 203A controls as follows:

| | |
|---|---|
| FREQUENCY | 10 |
| MULTIPLIER | 100 |
| ~ AMPLITUDE (2) | both CW |

c. AC Voltmeter should read at least 5.3 volts rms.

d. Using Distortion Analyzer, check total harmonic distortion present on signal. Distortion level should be more than 64 db (0.06%) below fundamental frequency reference level.

e. Repeat step d at a number of frequencies between 5 cps and 60 kc.

f. Repeat steps a through e for VARIABLE PHASE ~ OUTPUT.

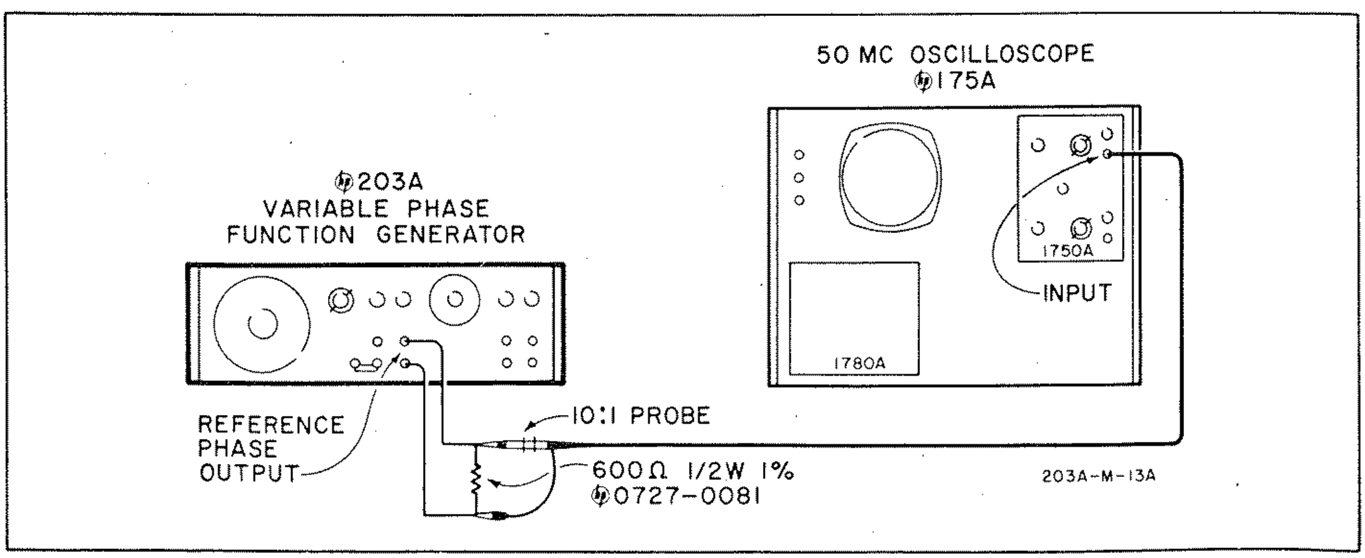



Figure 5-4. Square Wave Check

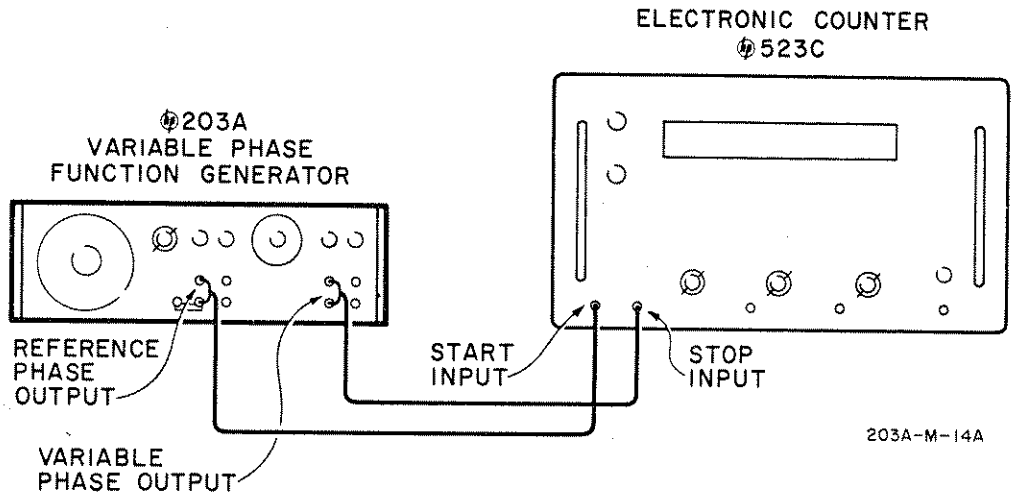



Figure 5-5. Phase Lag Check

5-8. SQUARE WAVE CHECK.

a. Connect Model 203A as shown in figure 5-4 .

b. Set instrument controls as follows:

Model 203A

| | |
|---|---|
| FREQUENCY | 10 |
| MULTIPLIER | 100 |
| ⊓⊔ AMPLITUDE (2) | both CW |

Oscilloscope

| | |
|---|---|
| INPUT | DC |
| SENSITIVITY | .5 V/CM |
| SWEEP TIME | .1 MSEC/CM |
| TRIGGER SOURCE | INT |
| TRIGGER SLOPE | (+) |

c. Adjust Model 203A FREQUENCY dial so that one cycle of square wave fills exactly 10 cm of horizontal deflection.

d. Zero crossing of square wave should occur between 4.8 and 5.2 cm from start of sweep. Peak-to-peak voltage should be at least 15 volts.

e. Set Oscilloscope SENSITIVITY to .5 v/cm. Adjust VERTICAL POSITION to bring first, the top of the square wave into view, then the bottom of the square wave.

f. Overshoot should not be more than 5% of the amplitude (1.5 cm).

g. Set Oscilloscope SWEEP TIME to .1 μSEC/CM; SENSITIVITY to .5 V/CM.

h. Square wave rise time should be less than 0.2 μsec from 10% to 90% points.

j. Set Oscilloscope TRIGGER SLOPE to (-).

k. Square wave fall time should be less than 0.2 μsec from 10% to 90% points.

m. Repeat steps b thru k at various frequencies on all ranges.

n. Repeat steps a thru m for VARIABLE PHASE ⊓⊔ OUTPUT.

5-9. PHASE LAG CHECK.

a. Connect Model 203A as shown in figure 5-1.

b. Set instrument controls as follows:

Model 203A

| | |
|---|---|
| MULTIPLIER | 10 |
| FREQUENCY | approximately 27 |
| ~ AMPLITUDE | both CW |

Electronic Counter

| | |
|---|---|
| FUNCTION SELECTOR | PERIOD |
| STD. FREQ. COUNTED | 1 MC |

c. Adjust Model 203A FREQUENCY dial for Electronic Counter reading of 3600.

d. Connect Model 203A as shown in figure 5-5.

e. Set Electronic Counter controls as follows:

| | |
|---|---|
| FUNCTION | TIME INTERVAL |
| TRIGGER INPUT | SEP |
| TRIGGER SLOPE | both (+) |

f. Set Model 203A PHASE LAG dial to 180°

g. Adjust Electronic Counter TRIGGER LEVEL controls for stable reading near 1800.

h. Check Electronic Counter readings at 30° increments on PHASE LAG dial. Readings should be within the values shown in table 5-3.

Table 5-3. Phase Lag Check

| PHASE LAG | ELECTRONIC COUNTER | |
|---|---|---|
| | Minimum | Maximum |
| 0 | 3550 | 50 |
| 30 | 250 | 350 |
| 60 | 550 | 650 |
| 90 | 850 | 950 |
| 120 | 1150 | 1250 |
| 150 | 1450 | 1550 |
| 180 | 1750 | 1850 |
| 210 | 2050 | 2150 |
| 240 | 2350 | 2350 |
| 270 | 2650 | 2750 |
| 300 | 2950 | 3050 |
| 330 | 3250 | 3350 |

## 5-10. INSTRUMENT COVER REMOVAL.

5-11. To remove either the top or bottom covers, unscrew and remove the two counter-sunk Phillips-head screws which secure the cover to the instrument. Then slide the cover toward the rear of the instrument. To replace the cover, reverse the procedure.

## 5-12. ADJUSTMENTS.

5-13. The following test and adjustment procedures should be performed only if it has been definitely determined by the Performance Checks given in paragraphs 5-5 thru 5-9 that the Model 203A is out of adjustment.

5-14. POWER SUPPLY A22 ADJUSTMENTS.

Note
Make the following adjustments with FREQUENCY MULTIPLIER switch in X100 position.

a. Supply Model 203A primary power from Variable Transformer.

b. Set line voltage to nominal value (115 volts).

c. Connect DC Voltmeter and AC Voltmeter to A22 (5). (See figure 5-21.)

d. Adjust A22R12 (-15 volt adjust) for DC Voltmeter reading of -15.1 vdc. AC Voltmeter should read less than 1.0 mv ripple.

e. Vary line voltage from 103 to 127 vac. DC Voltmeter reading should not change more than ±0.2 vdc.

f. Connect DC Voltmeter and AC Voltmeter to A22 (13).

g. Adjust A22R20 (+15 volt adjust) for DC Voltmeter reading of +15.1 dc. The AC Voltmeter should read less than 1.0 mv ripple.

h. Vary line voltage from 103 to 127 vac. DC Voltmeter reading should not change more than ±0.2 vdc.

j. Connect DC Voltmeter and AC Voltmeter to A22 (2).

k. AC Voltmeter should read less than 2.0 mv ripple. DC Voltmeter should read -24.5 ±0.5 vdc.

Note
It may be possible to bring the -24.5 volt supply into specifications by a slight adjustment of the -15 volt adjust (A22R12). The -15 volt supply must stay between -14.9 and -15.3 vdc.

m. Vary line voltage from 103 to 127 vac. DC Voltmeter reading should not change more than ±0.4 vdc.

n. Connect DC Voltmeter to A22 (14).

p. DC Voltmeter should read +35 ±5 vdc.

q. Disconnect front panel shorting bar.

r. Connect AC Voltmeter between chassis ground and circuit common A22 (9).

s. Use an insulated tuning wand to adjust A21C1 (located on bottom of chassis) for a minimum reading (refer to figure 5-8).

5-15. 4.995 MC OSCILLATOR AND 9:1 DIVIDER (A1) ADJUSTMENT.

a. Connect 10:1 probe of Oscilloscope to base of A1Q3 and ground lead to ground plane of oscillator board. (See figure 5-9.)

b. Set Oscilloscope controls as follows:

INPUT . . . . . . . . . . . . . . . . . . . . AC

SENSITIVITY . . . . . . . . . . . .05 V/CM

SWEEP TIME . . . . . . . . . . 2 μSEC/CM

c. Adjust A1T1 for maximum amplitude of 5 mc signal.

d. Move 10:1 probe to emitter of A1Q3.

e. Adjust A1L2 for eleven waveforms in 10 cm of horizontal deflection. Adjust A1L2 so that the first pip of signal is slightly larger than the rest (see figure 5-7, Waveforms 3 - 5).

f. Repeat steps a thru e until optimum adjustment is obtained.

g. Move probe to A1 (5).

h. Adjust A1T2 for maximum amplitude of 555 kc signal.

5-16. ADJUSTABLE PHASE SHIFTER (A25) ADJUSTMENT.

Note

The following procedure must be performed with printed board A2 in its normal operating position in the Model 203A. Do not use an extender board.

a. Connect AC Voltmeter across output of Phase Shifter Assembly (A25) using short unshielded leads (see figure 5-8).

b. While rotating PHASE LAG dial through 360° alternately adjust A2C1 (see figure 5-11) and A25C1 until voltage level indicated on AC Voltmeter remains with ±3% of nominal signal level obtained.

5-17. RF AMPLIFIER ADJUSTMENT (A2).

a. Connect DC Voltmeter to the collector of A2Q3; connect 10:1 Oscilloscope probe to collector of A2Q4. (See figure 5-11.)

b. Adjust A2L3 for maximum DC Voltmeter reading.

c. Adjust A2T1 for minimum AC voltage indication on Oscilloscope.

d. Repeat steps b and c as many times as necessary for optimum adjustment.

e. Connect DC Voltmeter to collector of A2Q7; connect 10:1 Oscilloscope probe to collector of A2Q8.

f. Adjust A2L7 for maximum DC Voltmeter reading.

g. Adjust A2T2 for minimum AC Voltage indication on Oscilloscope.

h. Repeat steps f and g as many times as necessary for optimum adjustment.

5-18. DECADE MODULE A11 ADJUSTMENT.

Note

Each of the six Decade Modules, A11 through A16 are electrically identical. Each module should be adjusted in the 1K position of the range switch for best results. All components are referred to by their location on the module. For example, L1 is A11L1, A12L1, A13L1, etc. depending upon the particular module under test. Module A11 procedure is given separately because of its wide frequency range.

a. Connect a 10:1 Oscilloscope probe to the junction of CR1 and CR2 (see figure 5-13b) and see the controls as follows:

| | |
|---|---|
| SENSITIVITY | .02v/cm |
| SWEEP TIME | 2 usec/cm |
| TRIGGER SOURCE | INT |

b. Set the frequency dial to 5 and the range switch to 1K.

c. Adjust T1 and L1 for maximum amplitude the 5 mc signal.

Note

L1 may have two peaks. The correct position of the slug is the second peak in the clockwise direction. The wrong position of the slug will be noted by a sawtooth waveform.

d. Move the 10:1 Oscilloscope probe to the base of Q3 and change the vertical sensitivity to .05v/cm.

e. Adjust T2 for maximum amplitude of the 5 mc signal.

f. Move the 10:1 Oscilloscope probe to the emitter of Q3.

g. Adjust L2 for eleven complete cycles in 10 cm of horizontal deflection. (See figure 5-7, waveform 12.)

h. Move the 10:1 Oscilloscope probe to the base of Q3.

i. Rotate the frequency dial slowly to the high end. The amplitude of the 5 mc signal should not fall below 1 cm (.5v p-p.)

j. If the signal at the high end of the dial is to low in amplitude, turn L1 slug counterclockwise until 1 cm of amplitude is obtained. Rotate the frequency dial from the high end to the low end and stagger tune L1 and T1 as necessary in order to maintain at least 1 cm of amplitude over the entire range.

k. Move the 10:1 Oscilloscope probe to the emitter of Q3 and set the frequency dial to 5.

l. Turn L2 slug clockwise until the waveform goes out of sync. Next turn L2 slug counterclockwise until the waveform just comes back into sync.

m. Rotate the frequency dial slowly toward the high end until the waveform goes out of sync.

n. Turn L2 slug counterclockwise until the waveform just comes back into sync.

o. Repeat steps m and n until the waveform is synchronized while rotating the dial between the extreme high and low ends.

p. Rotate the frequency dial until the first pip on the waveform is at maximum amplitude.

q. Turn L2 slug counterclockwise to reduce the amplitude of the first pip to one-half the amplitude noted in step p. The bottom of the first pip will be slightly lower in amplitude than any other part of the waveform.

5-19. MODULE A12 THROUGH A16 ADJUSTMENTS.

a. Connect the 10:1 oscilloscope probe to the junction of CR1 and CR2 (see figure 5-13b) and set the controls as follows:

| | |
|---|---|
| SENSITIVITY | .02v/cm |
| SWEEP TIME | 2 usec/cm |
| TRIGGER SOURCE | INT |

b. Set the frequency dial to any position and the range switch to the 1K position. (The reason for this setting is that the frequency range of these decades is small.

c. Adjust T1 and L1 for maximum 5 mc signal (see figure 5-7, waveform 8.)

d. Move the 10:1 oscilloscope probe to the base of Q3 and change the vertical sensitivity to .05v/cm.

e. Adjust T2 for maximum amplitude of the 5 mc signal.

f. Move the 10:1 oscilloscope probe to the emitter of Q3.

g. Adjust L2 for eleven complete cycles in 10 cm of horizontal deflection.

h. Rotate L2 slug clockwise until the waveform goes out of sync and then turn L2 counterclockwise until the waveform just comes back into sync. Note the amplitude of the first pip at the bottom of the waveform. Turn L2 slug counterclockwise until the amplitude of the first pip is reduced by one half.

5-20. FREQUENCY DIAL ADJUSTMENT.

a. Connect Model 203A as shown in figure 5-1. Adjust the dial to a precise setting of 6.

b. Set MULTIPLIER switch to 1K.

c. Set 6 on the dial exactly on the period count of 1667 ±2 counts. Thus the quick Calibration Feature (paragraph 4-56) should bring the entire range into specifications.

d. Check each FREQUENCY dial setting listed in table 5-2. If at any point the frequency lies outside the specified tolerance, adjust C11 by carefully bending its outer plates until the frequency is within the given tolerance. Check 6 on the dial again to be sure that it is exactly on frequency.

5-21. MODULATOR (A3) ADJUSTMENT.

a. Connect DC Voltmeter to A3 (12). (See figure 5-15.)

b. Adjust A3R13 for minimum DC Voltmeter reading (typically between +50 and -50 millivolts.)

c. Measure voltage at A3 (4); reading should not exceed 250 mv.

5-22. DISTORTION.

a. Connect Distortion Analyzer and 600 ohm 1% resistor, -hp- #0727-0081) to REFERENCE PHASE ~ OUTPUT terminals.

b. Set FREQUENCY dial to 5; MULTIPLIER to 1K.

c. Set PHASE LAG dial to obtain maximum distortion reading on Distortion Analyzer.

d. Adjust A3R17 for minimum distortion. (See figure 5-15.)

e. Connect Distortion Analyzer and 600 ohm resistor to VARIABLE PHASE ~ OUTPUT terminals.

f. Set PHASE LAG dial to obtain maximum distortion reading.

g. Adjust A3R31 for minimum distortion.

Note

Perform steps h thru r only if distortion is greater than -64 db (0.06%) below reference level. These steps will reduce only excessive eighth and tenth harmonics.

h. Check and adjust as necessary, modules A11 through A14 according to Table 5-4. In each case a 10:1 oscilloscope probe is connected to the base of Q3 and a minimum signal amplitude of .5v p-p should be maintained for proper circuit operation.

Table 5-4

| MODULE | RANGE | DIAL | MAXIMUM DISTORTION | IF<-64DB ADJUST |
|---|---|---|---|---|
| A11 | X100 | 5 | > -64 db | T1 |
| A11 | X100 | 50 | > -64 db | L1 |
| A12 | X10 | 5 | > -64 db | T1 |
| A13 | X1 | 5 | > -64 db | T1 |
| A14 | X.1 | 50 | > -64 db | T1 |

5-23. FREQUENCY RESPONSE.

a. Connect DC Voltmeter to REFERENCE PHASE ~ OUTPUT terminals.

b. Set FREQUENCY dial to 50, MULTIPLIER to 100 and both ~ AMPLITUDE controls fully clockwise.

c. Adjust A6R8 (A7R8 for VARIABLE PHASE) (DC Zero Adj) for minimum DC Voltmeter reading (typically between +20 and -20 millivolts). See figure 5-17.)

d. Disconnect DC Voltmeter.

Note

Do not place DC Amplifiers (A6 and A7) on extender board.

g. Set REFERENCE PHASE ~ AMPLITUDE for AC voltmeter reading of 4.9 vac.

CAUTION

DO NOT EXCEED 7.5 MV OUTPUT AS THERMAL CONVERTER IS VERY EASILY DAMAGED BY EXCESSIVE INPUT VOLTAGE.

h. Disconnect AC Voltmeter.

i. Carefully adjust REFERENCE PHASE ~ AMPLITUDE for a DC Voltmeter reading of 7.0 millivolts.

k. Set Model 203A MULTIPLIER switch to 1.

m. Adjust A3R20 (A3R34 for VARIABLE PHASE) (50 cps adj) until the DC Voltmeter reads 7.0 millivolts.

n. Set MULTIPLIER switch to 10. Note DC Voltmeter reading.

p. Set MULTIPLIER switch to 1K.

q. Adjust A4R2 (A5R2 for VARIABLE PHASE) (50 kc adj) until DC Voltmeter reads the same as in step j.

r. Repeat steps j thru q until readings at 50 cps, 500 cps and 50 kc are between 6.93 and 7.07 millivolts.

s. Repeat steps a thru r for the VARIABLE PHASE ~ OUTPUT.

t. Disconnect Thermal Converter and connect AC VTVM to REFERENCE PHASE ~ OUTPUT terminals. Set REFERENCE PHASE ~ AMPLITUDE fully clockwise.

u. Adjust A6R20 (A7R20 for VARIABLE PHASE) AMP. Adj for 10.6 volts.

v. Repeat steps t and u for the VARIABLE PHASE ~ OUTPUT.

5-24. PHASE LAG DIAL.

a. Connect Model 203A as shown in figure 5-6.

b. Set FREQUENCY dial to 10; MULTIPLIER switch to 100. Set both ~ AMPLITUDE controls fully clockwise.

c. Adjust PHASE LAG dial and one (not both) of the ~ AMPLITUDE controls for minimum reading on AC Voltmeter. Typical reading is less than 50 mv.

d. Loosen set screws and slip PHASE LAG dial until it reads exactly 180° at the null obtained in step c and then tighten the set screws.

Note

If a phase error is noted at different points on the dial, it may be necessary to slip the dial in order to minimize any errors.

5-25. SQUARE WAVE (A8 and A9) ADJUSTMENT.

a. Connect DC Voltmeter to Model 203A REFERENCE PHASE ⎍ OUTPUT.

b. Set Model 203A controls as follows:

| | |
|---|---|
| FREQUENCY | 10 |
| MULTIPLIER | 100 |
| ⎍ AMPLITUDE | both CW |

c. Adjust A8R9 for a minimum reading on dc voltmeter (typically between +50 and -50 millivolts). (See figure 5-17.)

d. Connect dc voltmeter to VARIABLE PHASE OUTPUT.

e. Adjust A9R9 for a minimum reading on dc voltmeter (typically between +50 and -50 millivolts).

## 5-26. TROUBLESHOOTING.

5-27. To locate trouble in the Model 203A, start with a thorough visual inspection of the instrument. Look for burned out or loose components and connections, and other similar conditions which suggest a source of trouble. For further aid in troubleshooting use Model 203A Block Diagram (figure 4-1), Purpose for Factory Selected Values (table 5-5), Troubleshooting Summary (table 5-6), and Typical Waveforms (figure 5-7).

## 5-28. PRINTED CIRCUIT BOARD REPAIR.

5-29. The Model 203A uses plated through double-sided etched circuit boards.

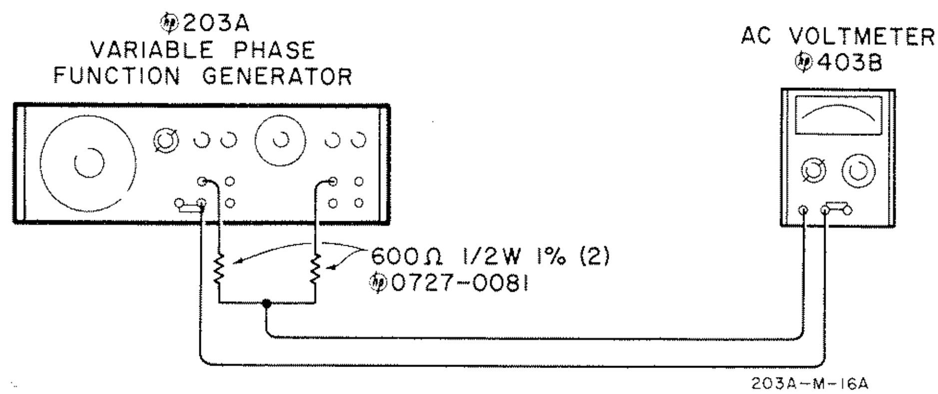



Figure 5-6. Phase Lag Dial Adjustment

5-30. Observe the following rules when repairing double-sided etched circuit boards.

a. Solder from the conductor side of the etched circuit board.

b. Avoid applying excessive heat when soldering on the circuit board.

c. To remove a damaged component, clip component leads near the component; then apply heat and remove each lead with a straight upward motion.

d. Use a special tool to remove components having multiple connections, such as potentiometers, etc. Refer to table 5-1 for type of soldering tip required.

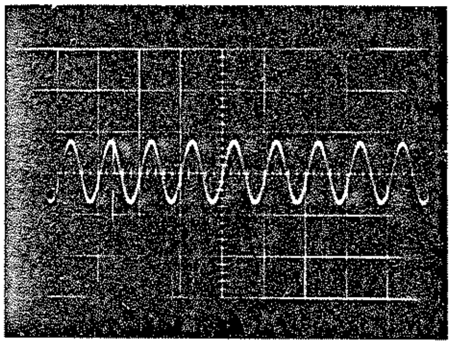
e. Use a toothpick to free hole of solder before installing a new component.

Table 5-5. Purpose of Factory Selected Values

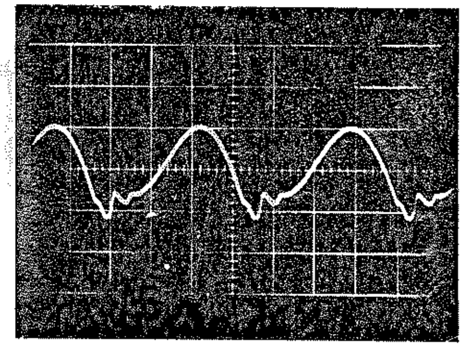
| | |
|---|---|
| A2C2* | To provide proper range for A2C1. (Adjust only if A25, A2Q1 or A2Q2 are changed.) |
| A2C7* | To provide proper amplitude for 90° A25 drive. (Adjust only if A25, A2Q1 or A2Q2 are changed.) |
| A2C11* | To provide proper amplitude for 0° A25 drive. (Adjust only if A25, A2Q1 or A2Q2 are changed.) |
| A3R5* | Value very seldom changed. Adjust drive amplitude for A3Q2. |
| A21C2* | To provide common ground isolation. |
| A22C2* | To eliminate H. F. oscillations on the -24.5 volt dc supply. |
| A22C12* | To eliminate H. F. oscillations on the -15 volt dc supply. |
| C12* | Do not change unless absolutely necessary! Coarse adjustment for 5 kc. |

Table 5-6. Troubleshooting Summary

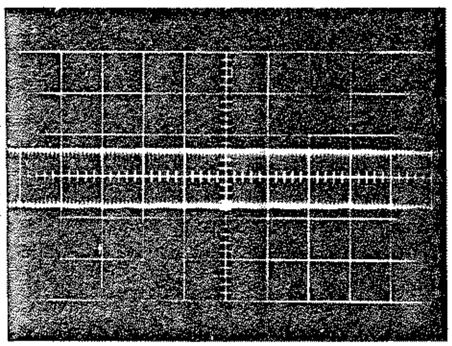
| Symptoms | Possible Cause |
|---|---|
| 1. No output on any channel | (1) Check: VFO output at XA10 pins 4 and 6 (X1K range).<br>(2) If no output, check 555 kc output XA1 pins 5 and 6.<br>(3) If no output at (2), check 4.995 Mc output XA1 pin 1.<br>(4) Check power supply voltages and continuity between circuit ground and chassis. If output is at (2) but not at (1), check:<br>a. A10L1, L2 for open.<br>b. A10C11, C15 for short.<br>c. A10C5, C8 for open.<br>(5) If output is at (3) but not at (2), check:<br>a. Open windings in A1T1, T2 or L2.<br>b. Low beta of A1Q3 or Q4.<br>(6) If no output at (3), check: (4) and crystal Y1, transistor A1Q1 |
| 2. Output on one channel only (sine and square) | (1) Check: output at pins 2 and 4 of XA6 or XA7.<br>(2) If no output, check pins 12 or 4 of XA3.<br>(3) If output is at (2) but not (1), check:<br>a. A4 or A5 at pin 6 then pin 1.<br>b. L1, L2 or L3 might have case grounded.<br>(4) If output is at (3) but not at pin 4 of XA3, check:<br>a. A3Q9, T2, T4 for open.<br>b. Misadjustment of A3R31 or R34.<br>(5) If output is at (3) but not at pin 12 of XA3, check:<br>a. A3Q4, T1 or T3 for open.<br>b. Misadjustment of A3R17 or R20. |
| 3. No square wave output | (1) Check: Input pin 1 of XA8 or XA9.<br>(2) If no signal, check output pin 2 of XA6 or XA7.<br>(3) If signal is at (1), check output pin 6 of XA8 or XA9.<br>(4) If signal is at (1) but not (3), check:<br>a. A8Q5, Q4 or CR1 for open.<br>b. A9Q5, Q4 or CR1 for open. |
| 4. No output on variable channel (sine and square) | (1) Check: output of RF Amplifier pin 7 of XA2.<br>(2) If no signal at (1), check input pin 4 of XA2.<br>(3) If no signal at (2), check pins 3 and 14 of XA2.<br>(4) If output is at (3) but not at (2), check components in A25.<br>(5) If no output at (1), no output at (2), check components listed under second symptom. |
| 5. High Distortion on one frequency range | (1) Adjust Decade Divider for that range. Use procedure in paragraph 5-18/5-19 |
| 6. Distortion on REF Sine OUTPUT varies as PHASE LAG dial is rotated | (1) Defective A2Q1 or A2Q2. |



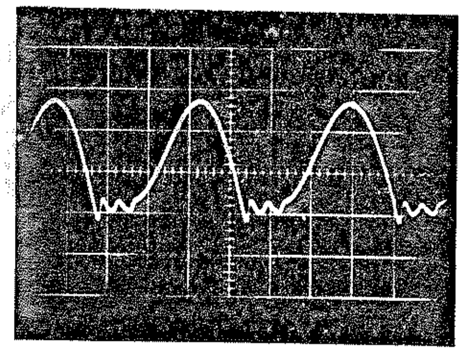
1- A1 (1) 5 mc output
.5 V/CM; .2 μSEC/CM



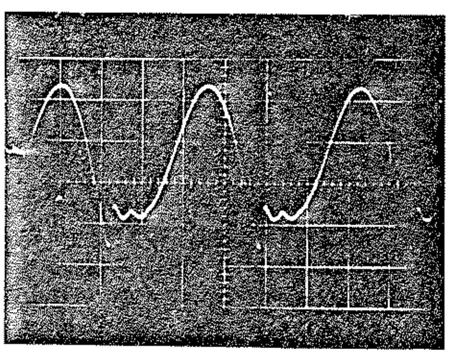
4- A1Q3 Emitter
A1L2 minimum for synchronization
.5 V/CM; .5 μSEC/CM



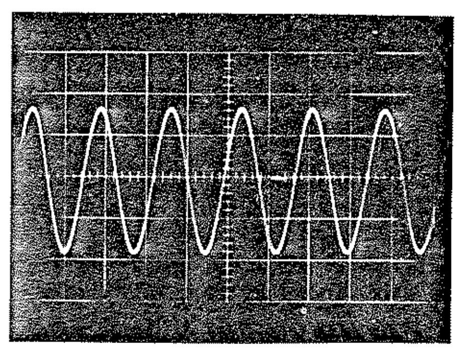
2 - A1Q3 Base
.5 V/CM; 2 μSEC/CM



5- A1Q3 Emitter
A1L2 nominal
.5 V/CM; .5 μSEC/CM

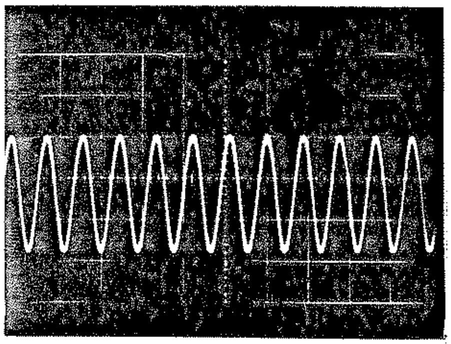


3- A1Q3 Emitter
A1L2 maximum for synchronization
.5 V/CM; .5 μSEC/CM

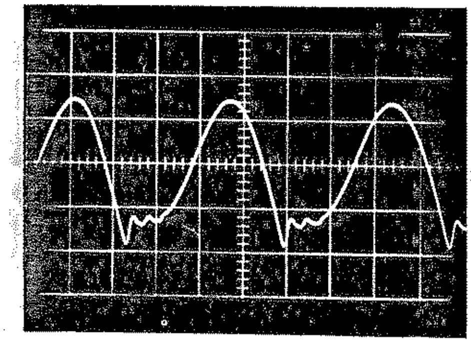


6- A2 (11) RF Amp Output
1 V/CM; 1 μSEC/CM

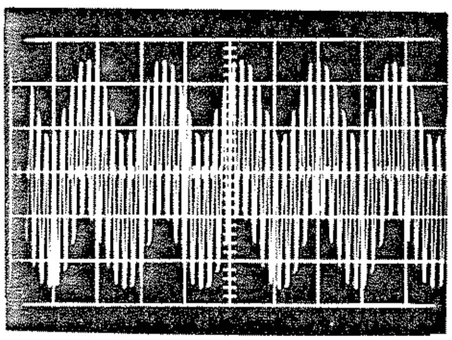
Figure 5-7. Typical Waveforms (Page 1 of 3)



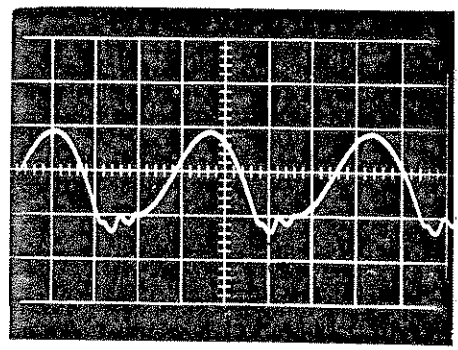
7- A10 (6) VFO Output
.5 V/CM; 2 μSEC/CM



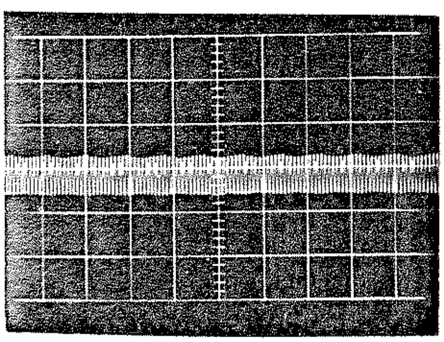
10- A11Q3 Emitter
L2 maximum for synchronization
.5 V/CM; .5 μSEC/CM



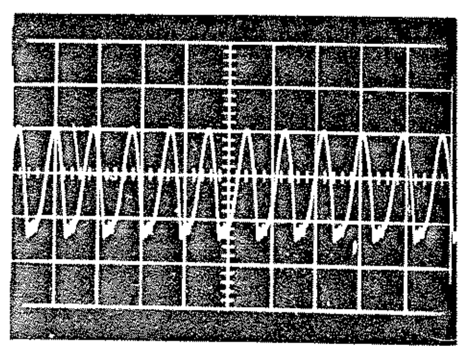
8- A11-Junction CR1 and CR2
.5 V/CM; 1 μSEC/CM



11- A11Q3 Emitter
L2 minimum for synchronization
.5 V/CM; .5 μSEC/CM

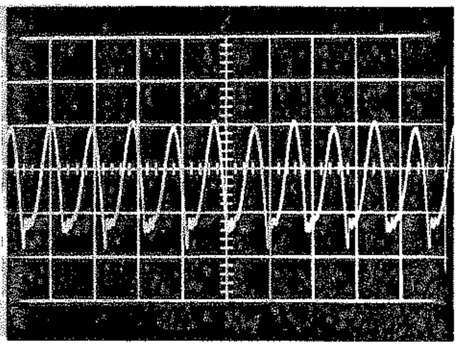


9- A11Q3 Base
.5 V/CM; 2 μSEC/CM

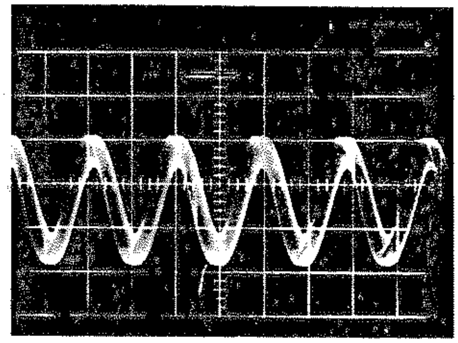


12- A11Q3 Emitter
L2 nominal
.5 V/CM; 2 μSEC/CM

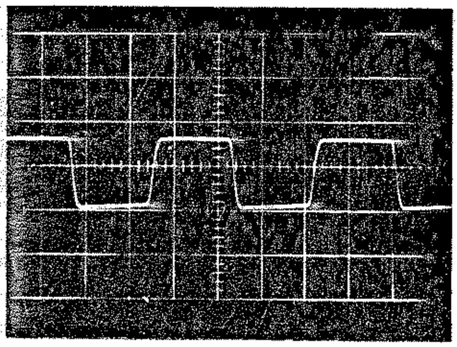
Figure 5-7. Typical Waveforms (Page 2 of 3)



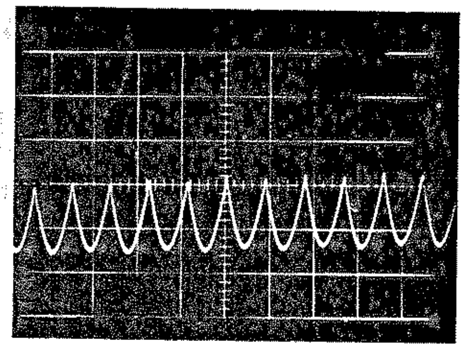
13- A11Q3 Emitter
Incorrect Frequency Division
.5 V/CM; 2 μSEC/CM



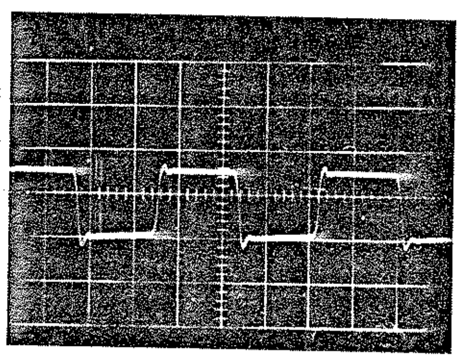
16- A3 (12) Modulator Output
FREQUENCY - 5 kc
.5 V/CM; .1 MSEC/CM



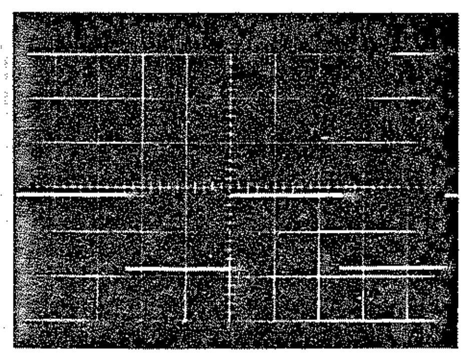
14- A3Q3 Collector
.5 V/CM; .5 μSEC/CM



17- A3 (12) Modulator Output
FREQUENCY - 5 kc
.5 V/CM; 1 μSEC/CM



15- A3Q5 Base
.5 V/CM; .5 μSEC/CM



18- A8Q4 Collector
FREQUENCY - 1 kc
5 V/CM; .2 μSEC/CM

Figure 5-7. Typical Waveforms (Page 3 of 3)

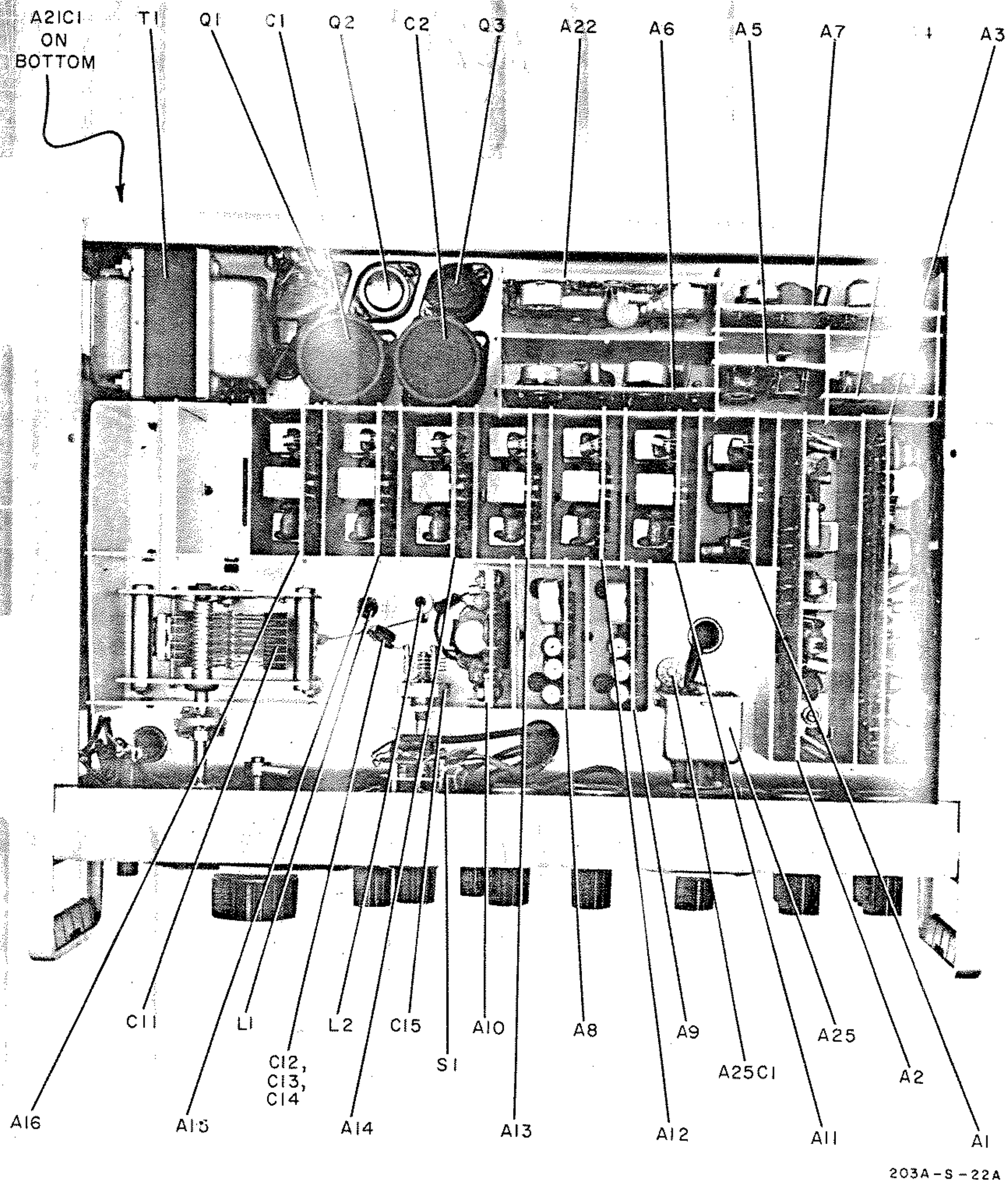



Figure 5-8. Chassis - Top View

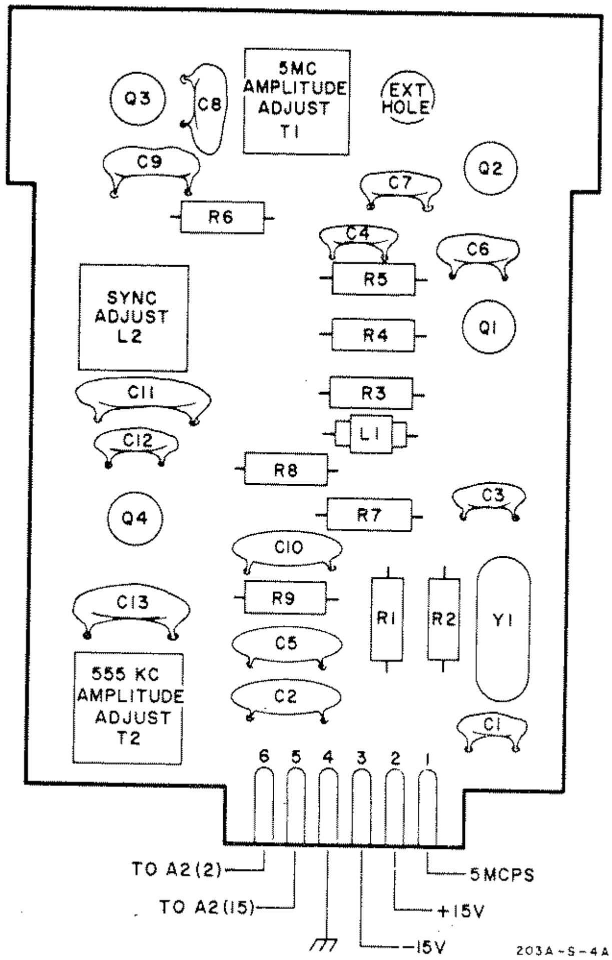



Figure 5-9. 5 Mc Oscillator and 9:1 Divider Assy A1--Component Location

NOTES

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN: PREFIX WITH ASSEMBLY OR SUBASSEMBLY DESIGNATION(S) OR BOTH FOR COMPLETE DESIGNATION.
2. COMPONENT VALUES ARE SHOWN AS FOLLOWS UNLESS OTHERWISE NOTED:
   RESISTANCE IN OHMS
   CAPACITANCE IN PICOFARADS
   INDUCTANCE IN MICROHENRYS
3. ——— — — ——— DENOTES ASSEMBLY.
4. ━━━━━━━━ DENOTES MAIN SIGNAL PATH.
5. ⊘ DENOTES SCREWDRIVER ADJUST.
6. ⏚ DENOTES CIRCUIT (FLOATING) GROUND.

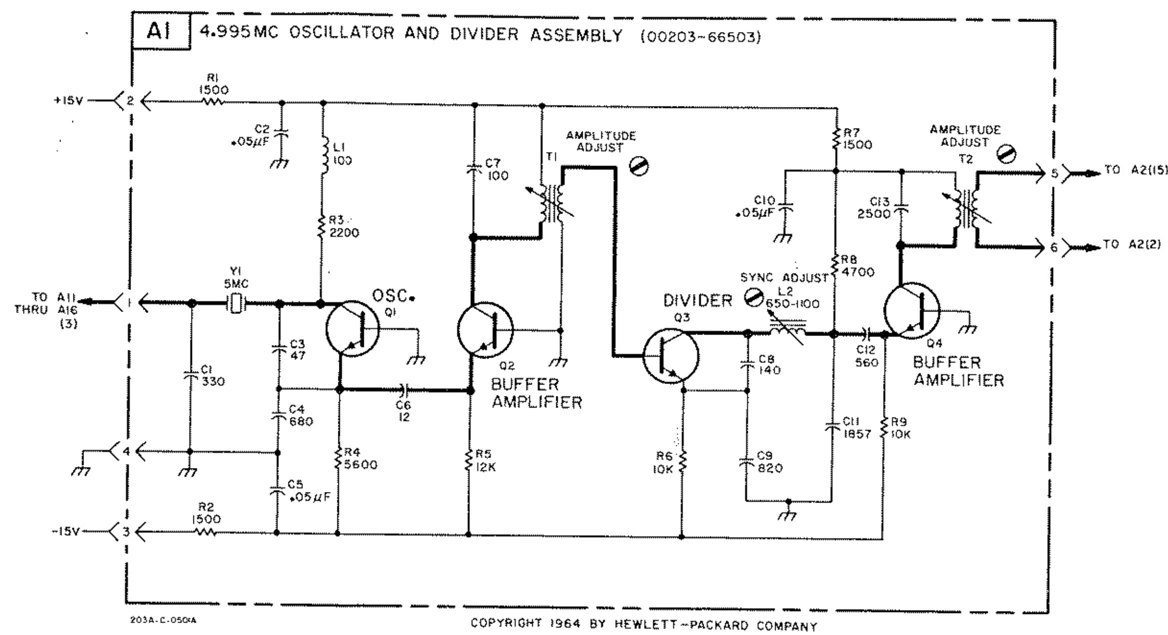





Figure 5-10. 5 Mc Oscillator and 9:1 Divider Assembly A1 -- Schematic

## NOTES

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN: PREFIX WITH ASSEMBLY OR SUBASSEMBLY DESIGNATION(S) OR BOTH FOR COMPLETE DESIGNATION.
2. COMPONENT VALUES ARE SHOWN AS FOLLOWS UNLESS OTHERWISE NOTED:

   RESISTANCE IN OHMS

   CAPACITANCE IN PICOFARADS
3. ——— — — ——— DENOTES ASSEMBLY.
4. ━━━━━━━━ DENOTES MAIN SIGNAL PATH.
5. —·—·—·—·— DENOTES FEEDBACK PATH.
6. ⊘ DENOTES SCREWDRIVER ADJUST.
7. * AVERAGE VALUE SHOWN, OPTIMUM VALUE SELECTED AT FACTORY.
8. ⏚ DENOTES CIRCUIT (FLOATING) GROUND.

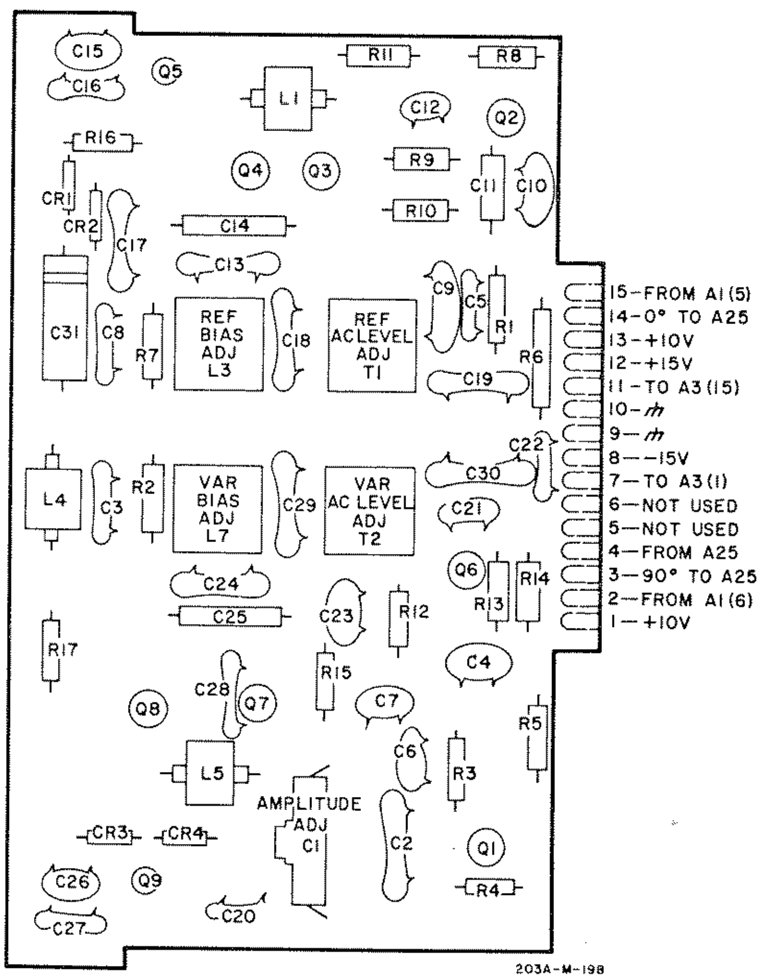



Figure 5-11. RF Amplifier Assy A2--Component Location

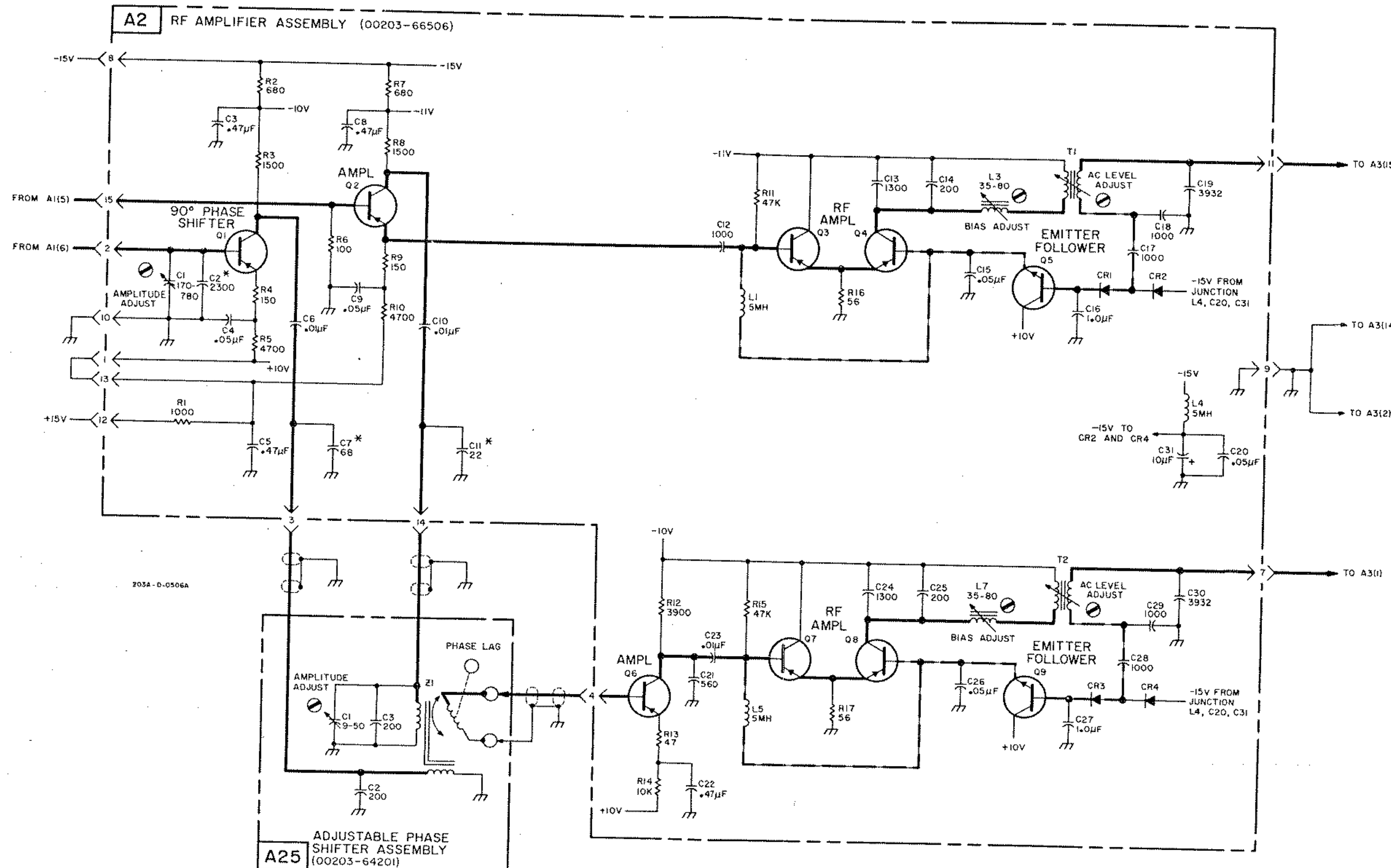







Figure 5-12. RF Amplifier Assy A2 and Adjustable Phase Shifter Assy A25 -- Schematic

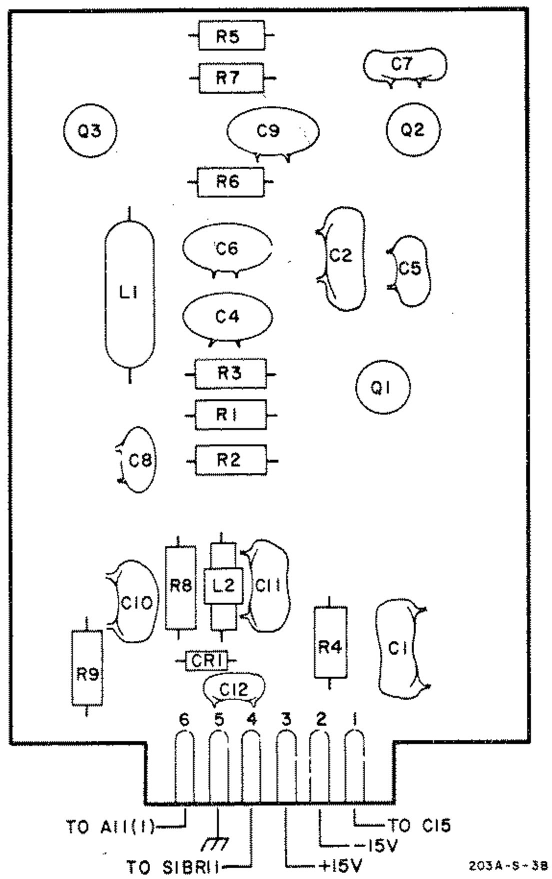



Figure 5-13a. VFO Assy A10--Component Location

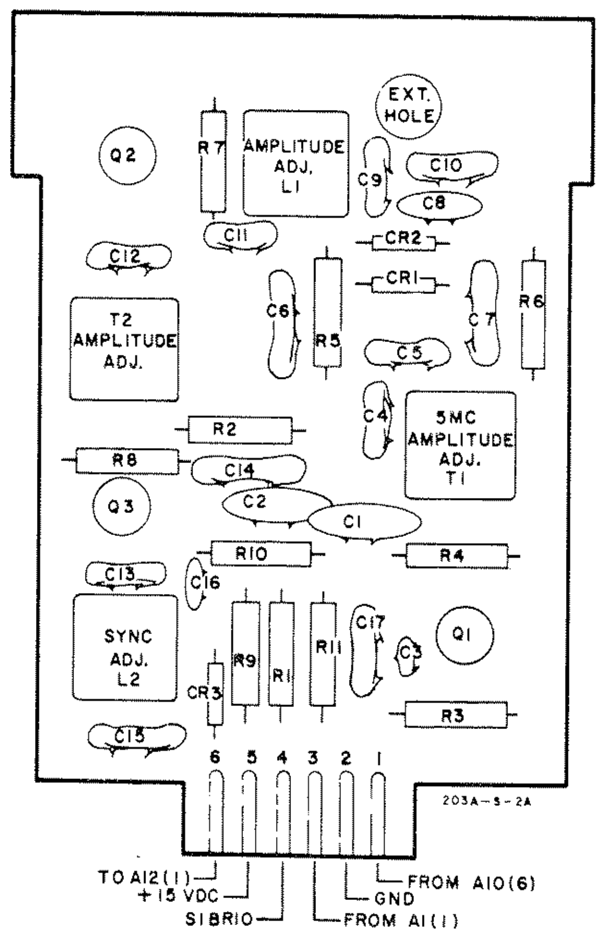
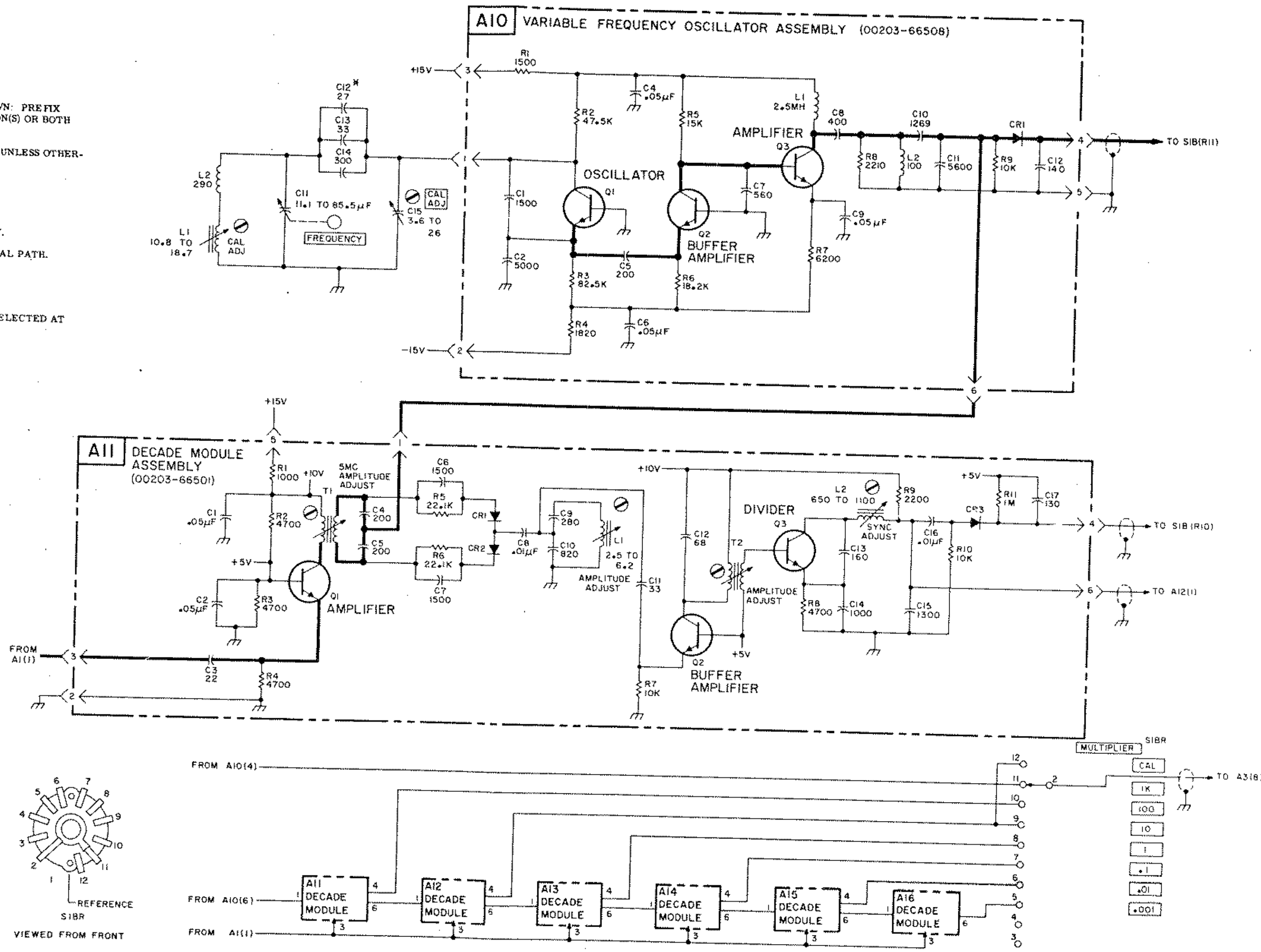
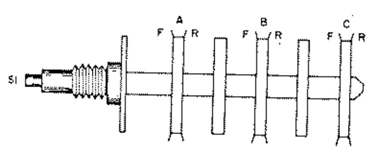



Figure 5-13b. Decade Module Assy A11--Component Location

## NOTES

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN: PREFIX WITH ASSEMBLY OR SUBASSEMBLY DESIGNATION(S) OR BOTH FOR COMPLETE DESIGNATION.
2. COMPONENT VALUES ARE SHOWN AS FOLLOWS UNLESS OTHERWISE NOTED:
   - RESISTANCE IN OHMS
   - CAPACITANCE IN PICOFARADS
   - INDUCTANCE IN MICROHENRYS
3. ——— — ——— DENOTES ASSEMBLY.
4. ▬▬▬▬ DENOTES MAIN SIGNAL PATH.
5. ▭ DENOTES FRONT PANEL MARKING.
6. ⊘ DENOTES SCREWDRIVER ADJUST.
7. * AVERAGE VALUE SHOWN. OPTIMUM VALUE SELECTED AT FACTORY.
8. ⏚ DENOTES CIRCUIT GROUND (FLOATING).






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01760-4

Figure 5-14. VFO Assy A10 and Decade Module Assy A11 to A16--Schematic

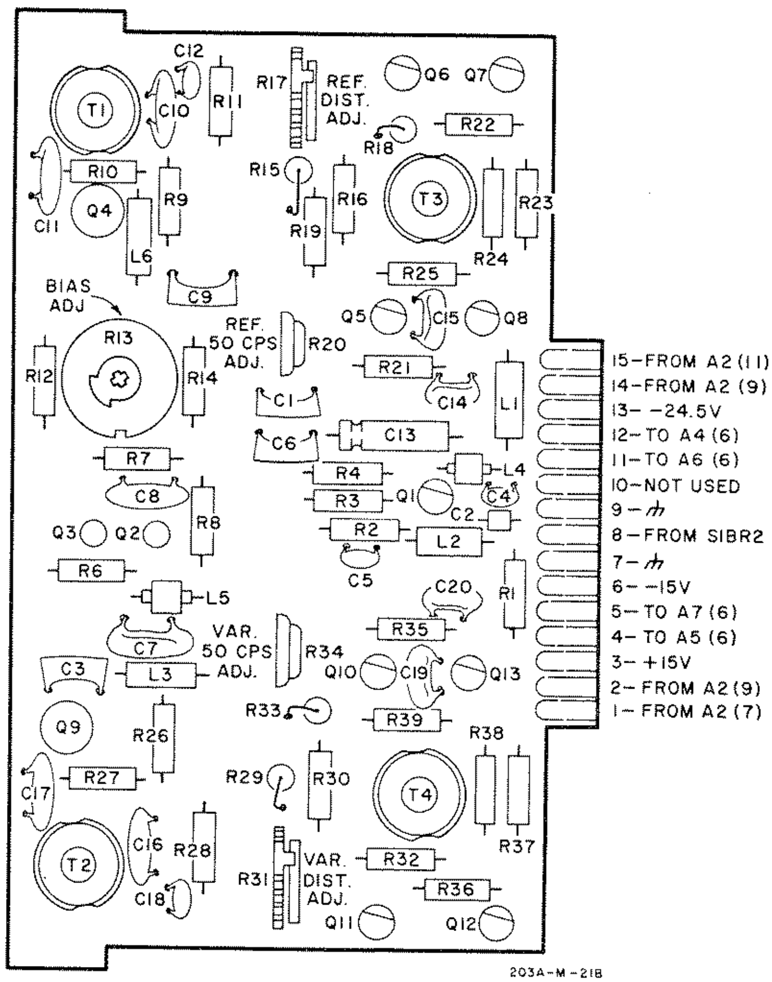
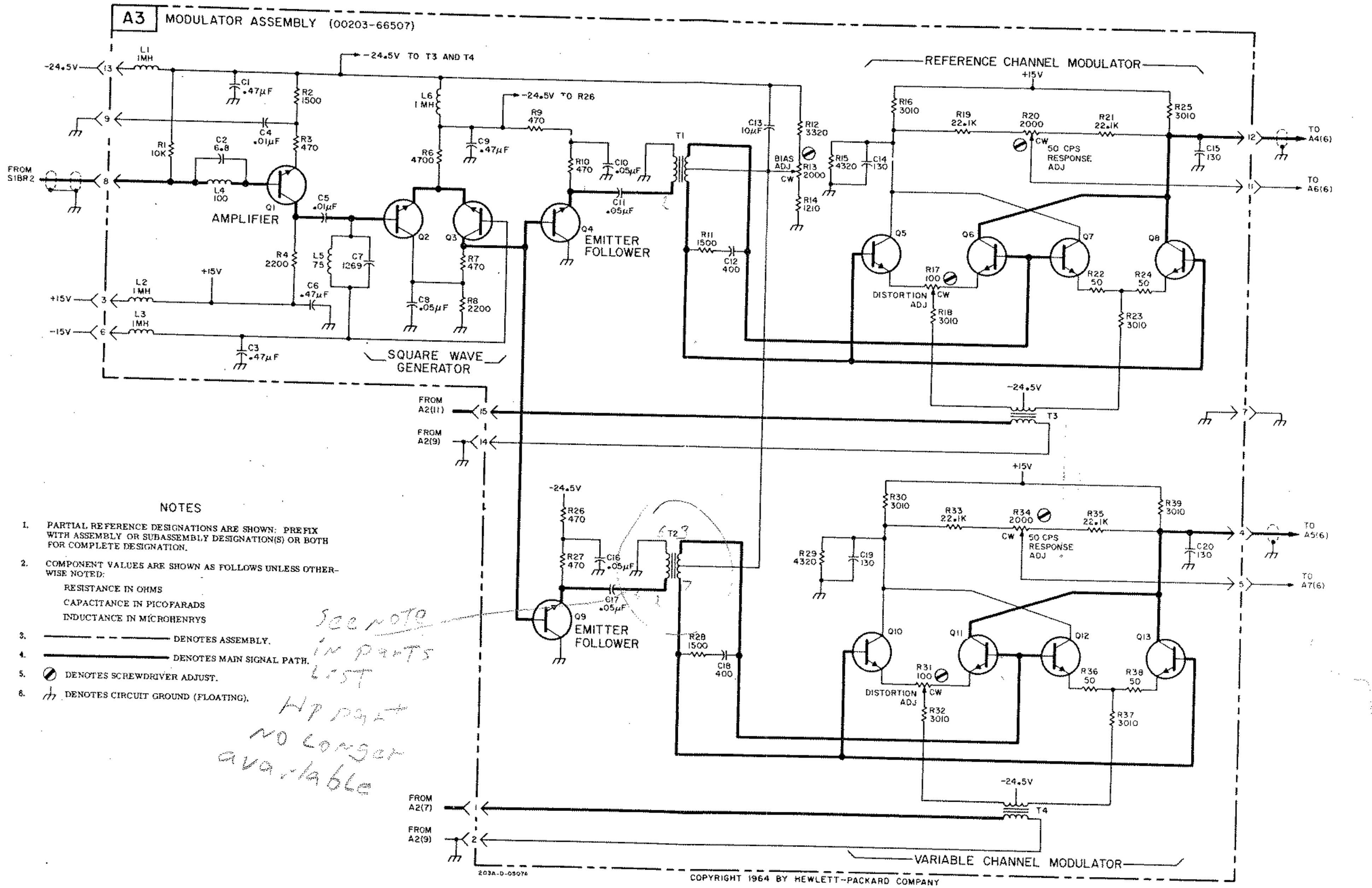



Figure 5-15. Modulator Assy A3--Component Location




NOTES

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN: PREFIX WITH ASSEMBLY OR SUBASSEMBLY DESIGNATION(S) OR BOTH FOR COMPLETE DESIGNATION.
2. COMPONENT VALUES ARE SHOWN AS FOLLOWS UNLESS OTHERWISE NOTED:
   - RESISTANCE IN OHMS
   - CAPACITANCE IN PICOFARADS
   - INDUCTANCE IN MICROHENRYS
3. ——— — — ——— DENOTES ASSEMBLY.
4. ━━━━━━━ DENOTES MAIN SIGNAL PATH.
5. ⊘ DENOTES SCREWDRIVER ADJUST.
6. ⏚ DENOTES CIRCUIT GROUND (FLOATING).

See note in parts list

HP part no longer available



Figure 5-16. Modulator Assy A3--Schematic

## NOTES

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN: PREFIX WITH ASSEMBLY OR SUBASSEMBLY DESIGNATION(S) OR BOTH FOR COMPLETE DESIGNATION.
2. COMPONENT VALUES ARE SHOWN AS FOLLOWS UNLESS OTHERWISE NOTED:
   - RESISTANCE IN OHMS
   - CAPACITANCE IN PICOFARADS
   - INDUCTANCE IN MICROHENRYS
3. ——— — — ——— DENOTES SUBASSEMBLY.
4. ━━━━━ DENOTES MAIN SIGNAL PATH.
5. —·—·—·— DENOTES FEEDBACK PATH.
6. ▭ DENOTES FRONT PANEL MARKING.
7. ⊘ DENOTES SCREWDRIVER ADJUST.
8. * AVERAGE VALUE SHOWN, OPTIMUM VALUE SELECTED AT FACTORY.
9. ⏚ DENOTES CIRCUIT GROUND (FLOATING).

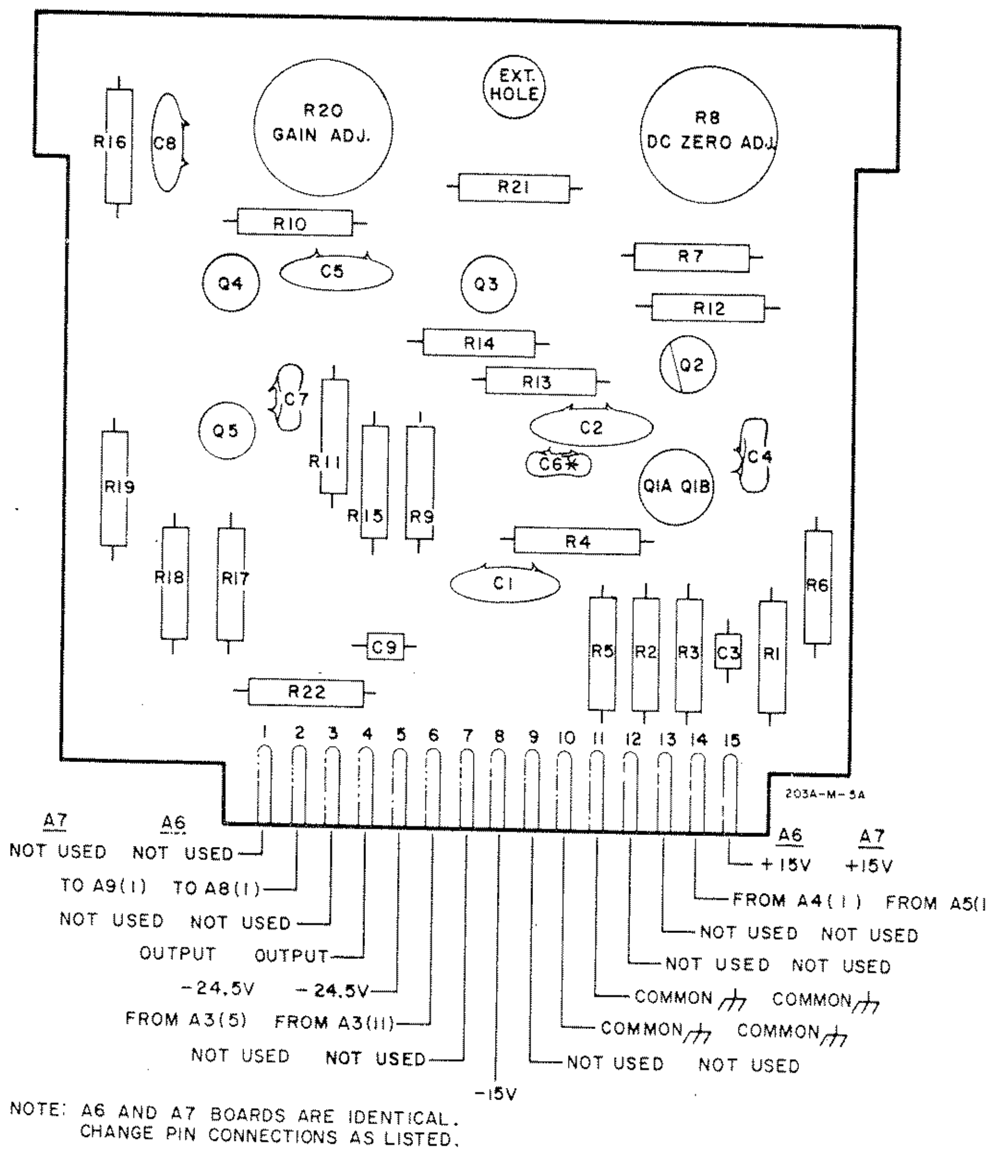
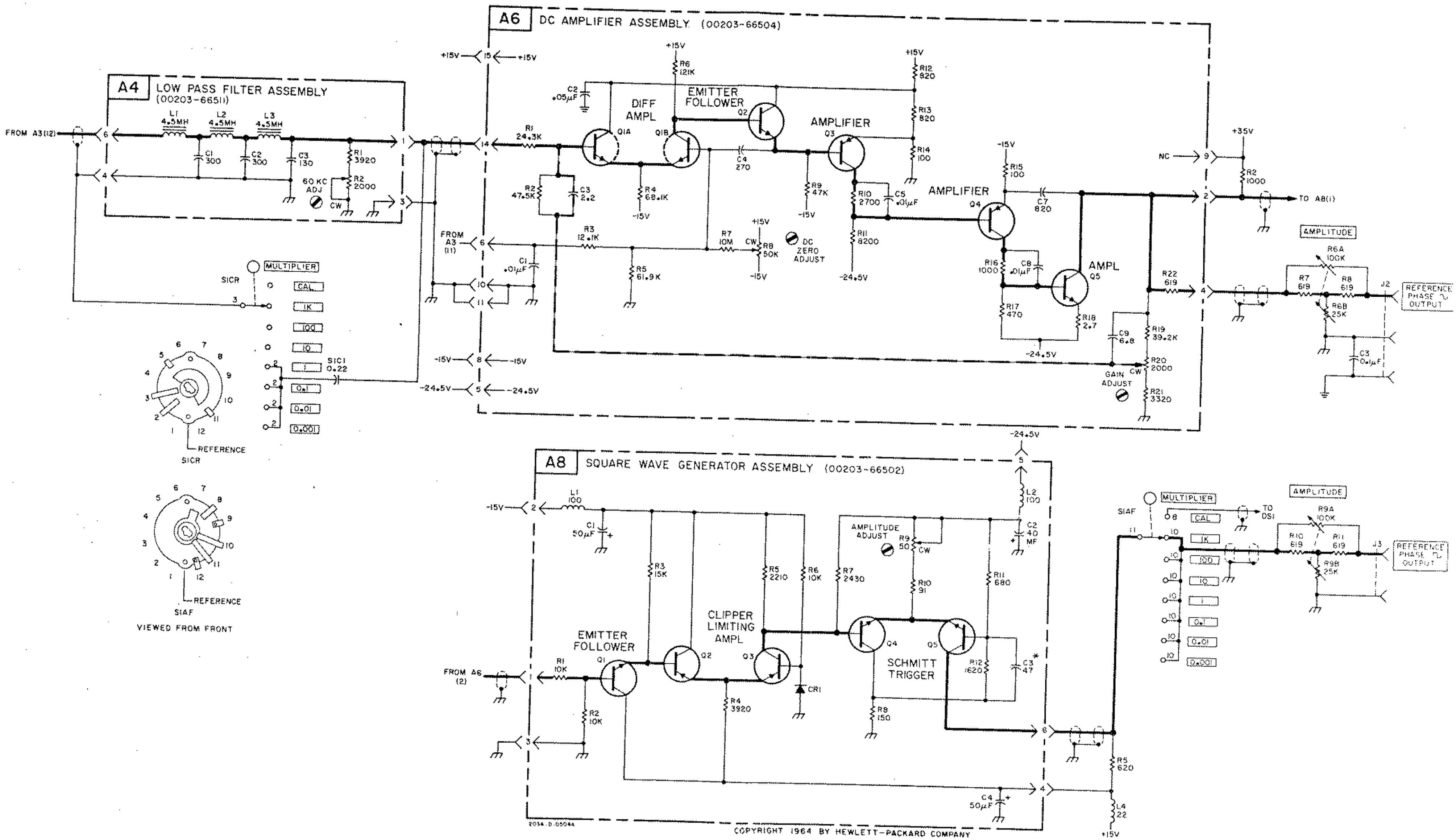



Figure 5-17. DC Amplifier Assy A6 and A7--Component Location




01760-3

Figure 5-18. Low Pass Filter Assy A4, DC Amp Assy A6, and Square Wave Gen Assy A8--Schematic

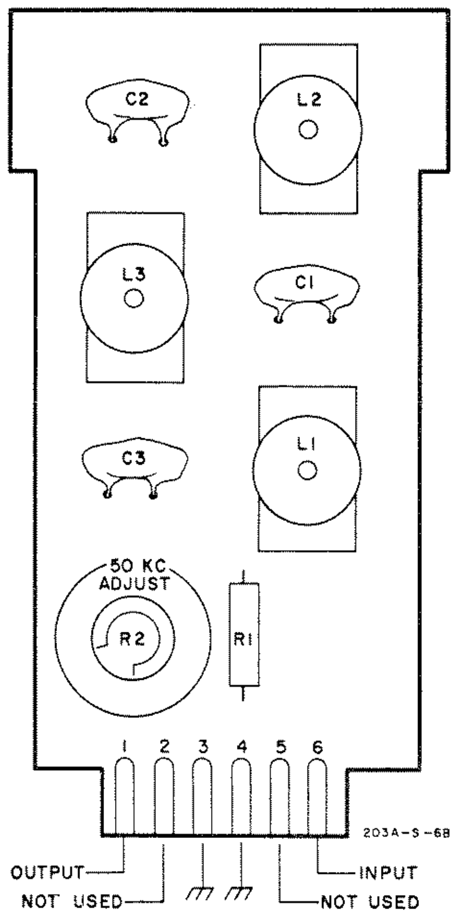



Figure 5-19a. Low Pass Filter Assy A4 and A5
Component Location

FROM

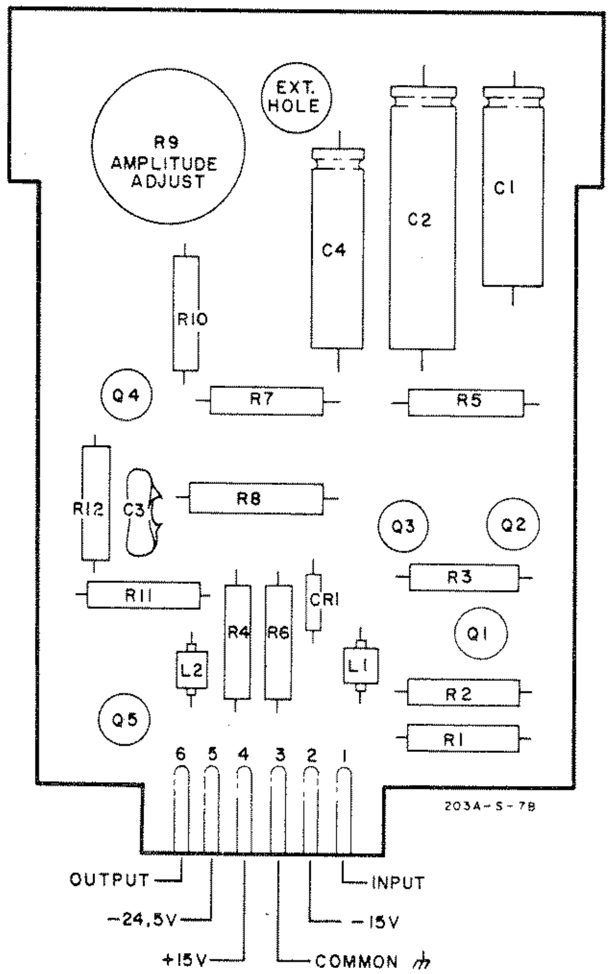
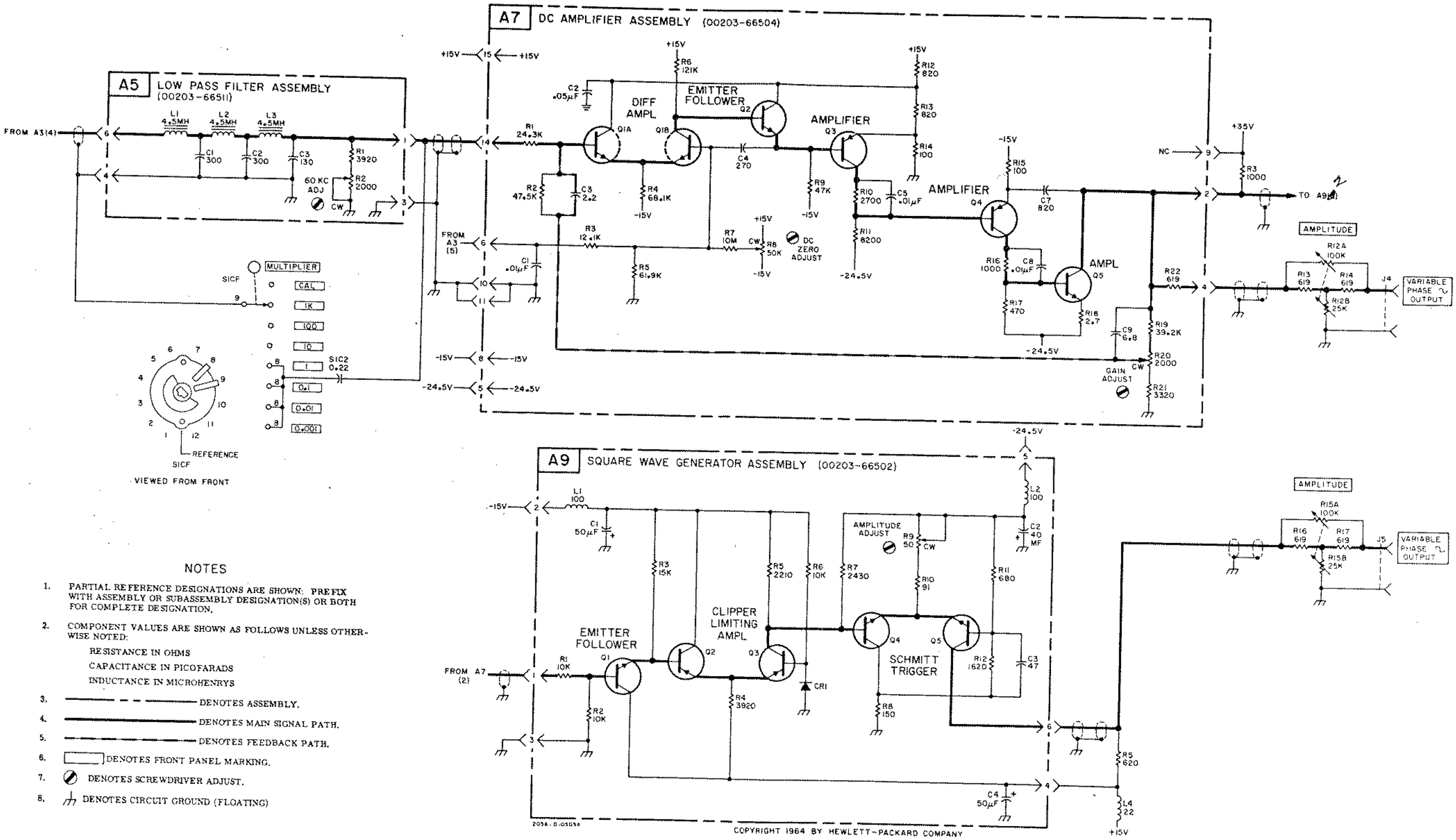



Figure 5-19b. Square Wave Gen Assy A8 and A9
Component Location




NOTES

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN: PREFIX WITH ASSEMBLY OR SUBASSEMBLY DESIGNATION(S) OR BOTH FOR COMPLETE DESIGNATION.
2. COMPONENT VALUES ARE SHOWN AS FOLLOWS UNLESS OTHERWISE NOTED:
   RESISTANCE IN OHMS
   CAPACITANCE IN PICOFARADS
   INDUCTANCE IN MICROHENRYS
3. — — — DENOTES ASSEMBLY.
4. ——— DENOTES MAIN SIGNAL PATH.
5. ——— DENOTES FEEDBACK PATH.
6. [ ] DENOTES FRONT PANEL MARKING.
7. ⊘ DENOTES SCREWDRIVER ADJUST.
8. ⏚ DENOTES CIRCUIT GROUND (FLOATING)

Figure 5-20. Low Pass Filter Assy A5, DC Amp Assy A7, and Square Wave Ge[illegible]y A9--Schematic

NOTES

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN: PREFIX WITH ASSEMBLY OR SUBASSEMBLY DESIGNATION(S) OR BOTH FOR COMPLETE DESIGNATION.

2. COMPONENT VALUES ARE SHOWN AS FOLLOWS UNLESS OTHERWISE NOTED:

   RESISTANCE IN OHMS

   CAPACITANCE IN PICOFARADS

   INDUCTANCE IN MICROHENRYS

3. DENOTES ASSEMBLY.

4. DENOTES MAIN SIGNAL PATH.

5. DENOTES SCREWDRIVER ADJUST.

6. DENOTES CIRCUIT GROUND (FLOATING).

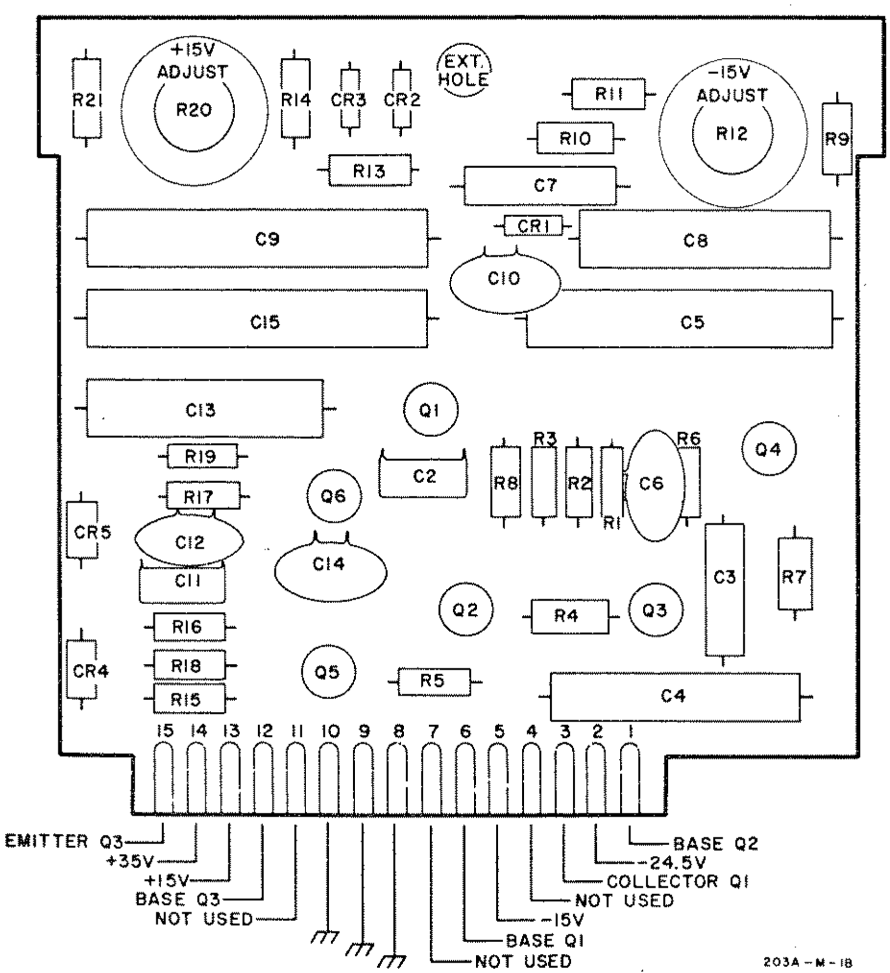



Figure 5-21. Power Supply Assy A22--Component Location

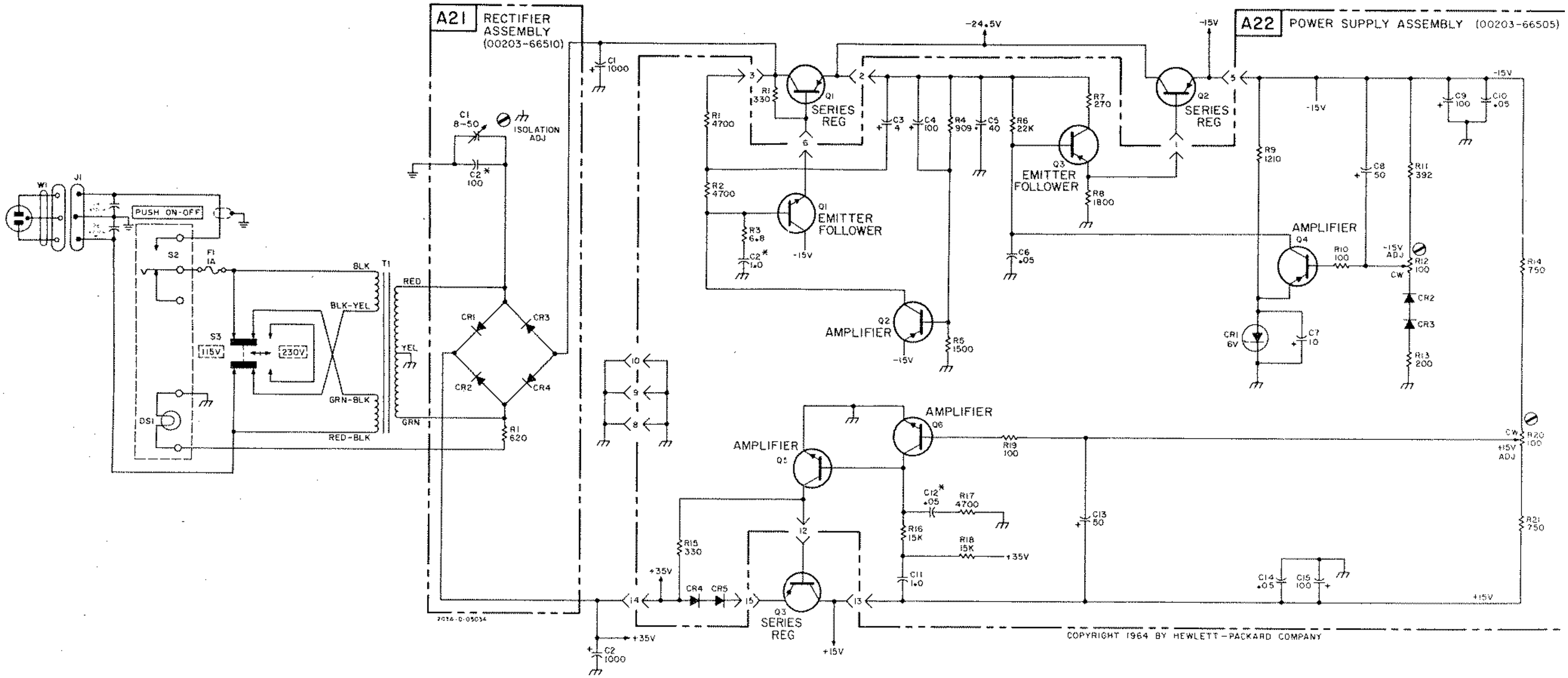
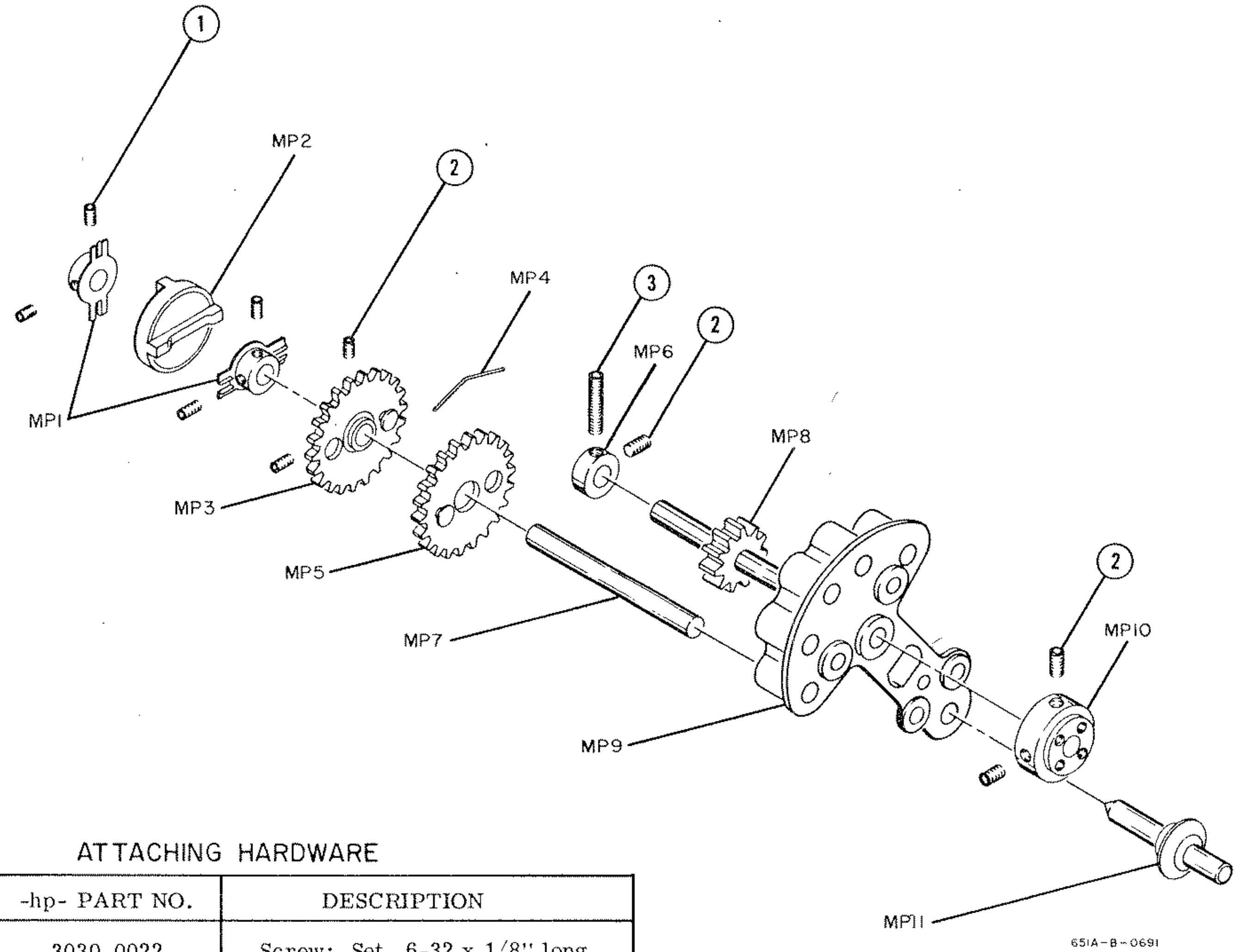





Figure 5-22. Power Supply Assy A22 and Rectifier Assy A21--Schematic




ATTACHING HARDWARE

| ITEM | -hp- PART NO. | DESCRIPTION |
|---|---|---|
| 1 | 3030-0022 | Screw: Set, 6-32 x 1/8" long |
| 2 | 3030-0001 | Screw: Set, 8-32 x 3/16" long |
| 3 | 3030-0004 | Screw: Set, 8-32 x 1" long |

Figure 5-23. Frequency Tuning Assembly (Mechanical Parts)

# SECTION VI
# REPLACEABLE PARTS

## 6-1 INTRODUCTION.

6-2. This section contains information for ordering replacement parts. Table 6-1 lists parts in alphameric order of their reference designators and indicates the description, -hp- part number of each part, together with any applicable notes, and provides the follows:

a. Total quantity used in the instrument (TQ column).

b. Description of the part. (See list of abbreviations below.)

c. Typical manufacturer of the part in a five-digit code. (See Appendix A for list of manufacturers.)

d. Manufacturer's part number.

6-3. Miscellaneous parts are listed at the end of Table 6-1.

## 6-4. ORDERING INFORMATION.

6-5. To obtain replacement parts, address order or inquiry to your local Hewlett-Packard Field Office. (See Appendix B for list of office locations.) Identify parts by their Hewlett-Packard part numbers.

## 6-6. NON-LISTED PARTS.

6-7. To obtain a part that is not listed, include:

a. Instrument model number.

b. Instrument serial number.

c. Description of the part.

d. Function and location of the part.

### DESIGNATORS

A = assembly
B = motor
BT = battery
C = capacitor
CR = diode
DL = delay line
DS = lamp
E = misc electronic part

F = fuse
FL = filter
HR = heater
J = jack
K = relay
L = inductor
M = meter
MP = mechanical part

P = plug
Q = transistor
QCR = transistor-diode
R = resistor
RT = thermistor
S = switch
T = transformer
TC = thermocouple

V = vacuum tube, neon bulb, photocell etc.
W = cable
X = socket
XDS = lampholder
XF = fuseholder
Z = network

### ABBREVIATIONS

Ag = silver
Al = aluminum
amp = ampere (s)
Au = gold

C = capacitor
cer = ceramic
coef = coefficient
com = common
comp = composition
conn = connection
cps = cycles per second

dep = deposited
DPDT = double-pole double-throw
DPST = double-pole single-throw

elect = electrolytic
encap = encapsulated

f = farad (s)
FET = field effect transistor
fxd = fixed

GaAs = gallium arsenide

Gc = gigacycle (s) = $10^{+9}$
gd = guard (ed)
Ge = germanium
grd = ground (ed)

h = henry (ies)
Hg = mercury

ID = inside diameter
impg = impregnated
incd = incandescent
ins = insulation (ed)

K = kilohm (s) = $10^{+3}$
Kc = kiloycycle (s) = $10^{+3}$

L = inductor
lin = linear taper
log = logarithmic taper

m = milli = $10^{-3}$
ma = milliampere (s) = $10^{-3}$
Mc = megacycle (s) = $10^{+6}$
meg = megohm (s) = $10^{+6}$
met flm = metal film
mfr = manufacturer
mtg = mounting
µ = micro = $10^{-6}$
my = Mylar ®

na = nanoampere (s) = $10^{-9}$
NC = normally closed
Ne = neon
NO = normally open
NPO = negative positive zero (zero temperature coefficient)

® Dupont de Nemours

ns = nanosecond (s) = $10^{-9}$
nsr = not separately replaceable

obd = order by description
OD = outside diameter

p = peak
pc = printed circuit
pf = picofarad (s) = $10^{-12}$
piv = peak inverse voltage
p/o = part of
pos = position (s)
poly = polystyrene
pot = potentiometer
p-p = peak-to-peak
prec = precision (temperature coefficient, long term stability, and/or tolerance)

R = resistor
Rh = rhodium
rms = root-mean-square
rot = rotary

Se = selenium
sect = section (s)
Si = silicon
sl = slide

SPDT = single-pole double-throw
SPST = single-pole single-throw

Ta = tantalum
$TiO_2$ = titanium dioxide
tog = toggle
tol = tolerance
trim = trimmer
TSTR = transistor

v = volt (s)
vacw = alternating current working volt (s)
var = variable
vdcw = direct current working volt (s)

w = watt (s)
w/ = with
wiv = reverse working voltage
w/o = without
ww = wirewound

* = optimum value selected at factory, average value shown (part may be omitted)
** = no standard type number assigned (selected or special type)

List of Reference Designators and Abbreviations

Table 6-1. Reference Designation Index

| REFERENCE DESIGNATION | STOCK NO. | DESCRIPTION | NOTE |
|---|---|---|---|
| A1 | 00203-66503 | Board ass'y, 5 mcps, includes:<br>C1 thru C13 R1 thru R9<br>L1, L2 T1, T2<br>Q1 thru Q4 Y1 | |
| A1C1 | 0140-0207 | C: fxd, dipped mica, 330 pf ±5% | |
| A1C2 | 0150-0096 | C: fxd, cer, 0.05 μfd +80% -20%, 100 vdcw | |
| A1C3 | 0140-0204 | C: fxd, dipped mica, 47 pf ±5% | |
| A1C4 | 0140-0208 | C: fxd, dipped mica, 680 pf ±5% | |
| A1C5 | 0150-0096 | C: fxd, cer, 0.05 μfd +80% -20%, 100 vdcw | |
| A1C6 | 0140-0201 | C: fxd, dipped mica, 12 pf ±5% | |
| A1C7 | 0140-0176 | C: fxd, dipped mica, 100 pf ±2% | |
| A1C8 | 0140-0217 | C: fxd, dipped mica, 140 pf ±2% | |
| A1C9 | 0140-0151 | C: fxd, dipped mica, 820 pf ±2% | |
| A1C10 | 0150-0096 | C: fxd, cer, 0.05 μfd +80% -20%, 100 vdcw | |
| A1C11 | 0140-0157 | C: fxd, dipped mica, 1857 pf ±1% | |
| A1C12 | 0140-0178 | C: fxd, dipped mica, 560 pf ±2% | |
| A1C13 | 0160-0147 | C: fxd, dipped mica, 2500 pf ±2% | |
| A1L1 | 9140-0029 | Coil, R. F., choke, universal wound, unshielded, 100 μh, 2.6 ohms | |
| A1L2 | 00203-86009 | Coil, var | |
| A1Q1 thru A1Q4 | 1854-0005 | Transistor, EIA type 2N708, NPN silicon planar | |
| A1R1, A1R2 | 0687-1521 | R: fxd, comp, 1500 ohms ±10%, 1/2 W | |
| A1R3 | 0687-2221 | R: fxd, comp, 2200 ohms ±10%, 1/2 W | |
| A1R4 | 0687-5621 | R: fxd, comp, 5600 ohms ±10%, 1/2 W | |
| A1R5 | 0687-1231 | R: fxd, comp, 12 K ohms ±10%, 1/2 W | |
| A1R6 | 0687-1031 | R: fxd, comp, 10 K ohms ±10%, 1/2 W | |
| A1R7 | 0687-1521 | R: fxd, comp, 1500 ohms ±10%, 1/2 W | |
| A1R8 | 0687-4721 | R: fxd, comp, 4700 ohms ±10%, 1/2 W | |
| A1R9 | 0687-1031 | R: fxd, comp, 10 K ohms ±10%, 1/2 W | |
| A1T1 | 00203-84204 | Transformer, tuned | |
| A1T2 | 00203-84203 | Transformer, tuned | |
| A1Y1 | 0410-0009 | Crystal unit, quartz, 5 mc, 2 pins on bottom | |
| A2 | 00203-66506 | Board ass'y, R. F. Amplifier, includes:<br>C1 thru C31 Q1 thru Q9<br>CR1 thru CR4 R1 thru R15<br>L1 thru L7 T1, T2 | |
| A2C1 | 0131-0003 | C: var, mica, single sect, 170 - 780 pf, 175 vdcw | |
| A2C2 * | 0160-0217 | C: fxd, dipped mica, 2300 pf ±1% | |
| A2C3 | 0160-0174 | C: fxd, cer, 0.47 μf +80% -20%, 25 vdcw | |
| A2C4 | 0150-0096 | C: fxd, cer, 0.05 μfd +80% -20%, 100 vdcw | |
| A2C5 | 0160-0174 | C: fxd, cer, 0.47 μf +80% -20%, 25 vdcw | |
| A2C6 | 0150-0012 | C: fxd, cer, 0.01 μf ±20%, 1000 vdcw | |
| A2C7 * | 0160-0376 | C: fxd, dipped mica, 68 pf ±5% | |
| A2C8 | 0160-0174 | C: fxd, cer, 0.47 μf +80% -20%, 25 vdcw | |
| A2C9 | 0150-0096 | C: fxd, cer, 0.05 μfd +80% -20%, 100 vdcw | |
| A2C10 | 0150-0012 | C: fxd, cer, 0.01 μf ±20%, 1000 vdcw | |
| A2C11 * | 0150-0145 | C: fxd, cer, 22 pf ±10%, 500 vdcw | |
| A2C12 | 0150-0069 | C: fxd, cer, 0.001 μf +100% -20%, 500 vdcw | |
| A2C13 | 0140-0154 | C: fxd, dipped mica, 1300 pf ±5% | |
| A2C14 | 0160-3132 | C: fxd, cer, 200 pf ±10%, 500 vdcw | |
| A2C15 | 0150-0096 | C: fxd, cer, 0.05 μfd +80% -20%, 100 vdcw | |

* Average value shown, optimum value selected at factory
# See introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

| REFERENCE DESIGNATION | ⓗ STOCK NO. | DESCRIPTION | NOTE |
|---|---|---|---|
| A2C16 | 0160-0127 | C: fxd, cer, 1.0 μf ±20%, 25 vdcw | |
| A2C17, A2C18 | 0140-0152 | C: fxd, mica, 1000 pf ±5%, 300 vdcw | |
| A2C19 | 0140-0161 | C: fxd, dipped mica, 3932 pf ±1% | |
| A2C20 | 0150-0096 | C: fxd, cer, 0.05 μfd +80% -20%, 100 vdcw | |
| A2C21 | 0140-0178 | C: fxd, dipped mica, 560 pf ±2% | |
| A2C22 | 0160-0174 | C: fxd, cer, 0.47 μf +80% -20%, 25 vdcw | |
| A2C23 | 0150-0012 | C: fxd, cer, 0.01 μf ±20%, 1000 vdcw | |
| A2C24 | 0140-0154 | C: fxd, dipped mica, 1300 pf ±5% | |
| A2C25 | 0160-3132 | C: fxd, cer, 200 pf ±10%, 500 vdcw | |
| A2C26 | 0150-0096 | C: fxd, cer, 0.05 μfd +80% -20%, 100 vdcw | |
| A2C27 | 0160-0127 | C: fxd, cer, 1.0 μf ±20%, 25 vdcw | |
| A2C28, A2C29 | 0140-0152 | C: fxd, mica, 1000 pf ±5%, 300 vdcw | |
| A2C30 | 0140-0161 | C: fxd, dipped mica, 3932 pf ±1% | |
| A2C31 | 0180-0059 | C: fxd, elect, 10 μf -10% +100%, 25 vdcw | |
| A2CR1 thru A2CR4 | 1901-0040 | Diode, silicon, 30 MA at +1 v, 30 PIV, 2 pf, 2 ns | |
| A2L1 | 9140-0037 | Coil, radio freq. 5 mh induct, universal wound | |
| A2L2 | | Not assigned | |
| A2L3 | 00203-86003 | Coil, var | |
| A2L4, A2L5 | 9140-0037 | Coil, radio freq. 5 mh induct, universal wound | |
| A2L6 | | Not assigned | |
| A2L7 | 00203-86010 | Coil, var | |
| A2Q1 thru A2Q4 | 1853-0016 | Transistor, 2N3638 PNP silicon | |
| A2Q5 | 1854-0033 | Transistor, EIA type 2N3391, NPN silicon | |
| A2Q6 thru A2Q8 | 1853-0016 | Transistor, 2N3638 PNP silicon | |
| A2Q9 | 1854-0033 | Transistor, EIA type 2N3391, NPN silicon | |
| A2R1 | 0687-1021 | R: fxd, comp, 1000 ohms ±10%, 1/2 W | |
| A2R2 | 0687-6811 | R: fxd, comp, 680 ohms ±10%, 1/2 W | |
| A2R3 | 0757-0736 | R: fxd, met flm, 1.5 K ohms ±1%, 1/4 W | |
| A2R4 | 0757-0715 | R: fxd, met flm, 150 ohms ±1%, 1/4 W | |
| A2R5 | 0687-4721 | R: fxd, comp, 4700 ohms ±10%, 1/2 W | |
| A2R6 | 0757-1032 | R: fxd, met flm, 100 ohms ±0.5%, 1/4 W | |
| A2R7 | 0687-6311 | R: fxd, comp, 680 ohms ±10%, 1/2 W | |
| A2R8 | 0757-0736 | R: fxd, met flm, 1.5 K ohms ±1%, 1/4 W | |
| A2R9 | 0757-0715 | R: fxd, met flm, 150 ohms ±1%, 1/4 W | |
| A2R10 | 0687-4721 | R: fxd, comp, 4700 ohms ±10%, 1/2 W | |
| A2R11 | 0687-4731 | R: fxd, comp, 47 K ohms ±10%, 1/2 W | |
| A2R12 | 0687-3921 | R: fxd, comp, 3900 ohms ±10%, 1/2 W | |
| A2R13 | 0687-4701 | R: fxd, comp, 47 ohms ±10%, 1/2 W | |
| A2R14 | 0687-1031 | R: fxd, comp, 10 K ohms ±10%, 1/2 W | |
| A2R15 | 0687-4731 | R: fxd, comp, 47 K ohms ±10%, 1/2 W | |
| A2R16, A2R17 | 0687-5601 | R: fxd, comp, 56 ohms | |
| A2T1 | 00203-84205 | Transformer, tuned | |
| A2T2 | 00203-84206 | Transformer, tuned | |

# See introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

| REFERENCE DESIGNATION | ⓗ STOCK NO. | DESCRIPTION | NOTE |
|---|---|---|---|
| A3 | 00203-66507 | Board, ass'y, modulator, includes:<br>C1 thru C20 R1 thru R39<br>L1 thru L6 T1 thru T4<br>Q1 thru Q13 | |
| A3C1 | 0160-0174 | C: fxd, cer, 0.47 µf +80% -20%, 25 vdcw | |
| A3C2 | 0150-0047 | C: fxd, $TiO_2$, 6.8 pf ±10%, 500 vdcw | |
| A3C3 | 0160-0174 | C: fxd, cer, 0.47 µf +80% -20%, 25 vdcw | |
| A3C4, A3C5 | 0150-0093 | C: fxd, cer, 0.01 µf +80% -20%, 100 vdcw | |
| A3C6 | 0160-0174 | C: fxd, cer, 0.47 µf +80% -20%, 25 vdcw | |
| A3C7 | 0140-0153 | C: fxd, mica, 1269 pf ±1%, 300 vdcw | |
| A3C8 | 0150-0096 | C: fxd, cer, 0.05 µfd +80% -20%, 100 vdcw | |
| A3C9 | 0160-0174 | C: fxd, cer, 0.47 µf +80% -20%, 25 vdcw | |
| A3C10, A3C11 | 0150-0096 | C: fxd, cer, 0.05 µfd +80% -20%, 100 vdcw | |
| A3C12 | 0150-0071 | C: fxd, cer, 400 pf ±5%, 500 vdcw | |
| A3C13 | 0180-0059 | C: fxd, elect, 10 µf -10% +100%, 25 vdcw | |
| A3C14, A3C15 | 0140-0195 | C: fxd, dipped mica, 150 pf ±5% | |
| A3C16, A3C17 | 0150-0096 | C: fxd, cer, 0.05 µfd +80% -20%, 100 vdcw | |
| A3C18 | 0150-0071 | C: fxd, cer, 400 pf ±5%, 500 vdcw | |
| A3C19, A3C20 | 0140-0195 | C: fxd, dipped mica, 130 pf ±5% | |
| A3L1 thru A3L3 | 9140-0137 | Coil, fixed R. F., 1000 µh ±5%, dc current rating 135 ma | |
| A3L4 | 9140-0029 | Coil, R. F. choke, universal wound, unshielded, 100 µh, 2.6 ohms | |
| A3L5 | 9140-0031 | Coil, R. F., 75 µh | |
| A3L6 | 9140-0137 | Coil, fxd, R. F. 1000 µh ±5%, dc current rating 135 ma | |
| A3Q1 | 1854-0033 | Transistor, EIA type 2N3391, NPN silicon | |
| A3Q2, A3Q3 | 1854-0005 | Transistor, EIA type 2N708, NPN silicon planar | |
| A3Q4 | 1854-0039 | Transistor, EIA type 2N3053, NPN silicon | |
| A3Q5 thru A3Q8 | 1854-0033 | Transistor, EIA type 2N3391, NPN silicon | |
| A3Q9 | 1854-0039 | Transistor, EIA type 2N3053, NPN silicon | |
| A3Q10 thru A3Q13 | 1854-0033 | Transistor, EIA type 2N3391, NPN silicon | |
| A3R1 | 0687-1031 | R: fxd, comp, 10K ohms ±10%, 1/2 W | |
| A3R2 | 0687-1521 | R: fxd, comp, 1500 ohms ±10%, 1/2 W | |
| A3R3 | 0687-4711 | R: fxd, comp, 470 ohms ±10%, 1/2 W | |
| A3R4 | 0687-2221 | R: fxd, comp, 2200 ohms ±10%, 1/2 W | |
| A3R5* | 0683-4715 | R: fxd, comp, 470 ohms, ±5%, 1/4 W | |
| A3R6 | 0687-4721 | R: fxd, comp, 4700 ohms ±10%, 1/2 W | |
| A3R7 | 0687-4711 | R: fxd, comp, 470 ohms ±10%, 1/2 W | |
| A3R8 | 0687-2221 | R: fxd, comp, 2200 ohms ±10%, 1/2 W | |
| A3R9, A3R10 | 0687-4711 | R: fxd, comp, 470 ohms ±10%, 1/2 W | |
| A3R11 | 0687-1521 | R: fxd, comp, 1500 ohms ±10%, 1/2 W | |
| A3R12 | 0757-0743 | R: fxd, met flm, 3.32 K ohms ±1%, 1/4 W | |
| A3R13 | 2100-0282 | R: var, lin, ww, 2000 ohms ±20%, 1-1/2 W | |
| A3R14 | 0757-0743 | R: fxd, met flm, 1.21K ohms ±1%, 1/4 W | |
| A3R15 | 0757-0745 | R: fxd, met flm, 4.32K ohms ±1%, 1/4 W | |
| A3R16 | 0757-0339 | R: fxd, met flm, 3.01K ohms ±1%, 1/4 W | |

*Average value shown, optimum value selected at factory

# See introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

| REFERENCE DESIGNATION | ⓗⓟ STOCK NO. | DESCRIPTION | NOTE |
|---|---|---|---|
| A3R17 | 2100-0909 | R: var, comp, lin, 100 ohms ±30%, 1/4 W | |
| A3R18 | 0757-0339 | R: fxd, met flm, 3.01K ohms ±1%, 1/4 W | |
| A3R19 | 0757-0761 | R: fxd, met flm, 22.1K ohms ±1%, 1/4 W | |
| A3R20 | 2100-0908 | R: var, comp, lin, 2K ±30%, 1/4 W | |
| A3R21 | 0757-0761 | R: fxd, met flm, 22.1K ohms ±1%, 1/4 W | |
| A3R22 | 0757-1040 | R: fxd, met flm, 50 ohms ±1%, 1/4 W | |
| A3R23 | 0757-0339 | R: fxd, met flm, 3.01K ohms ±1%, 1/4 W | |
| A3R24 | 0757-1040 | R: fxd, met flm, 50 ohms ±1%, 1/4 W | |
| A3R25 | 0757-0339 | R: fxd, met flm, 3.01K ohms ±1%, 1/4 W | |
| A3R26, A3R27 | 0687-4711 | R: fxd, comp, 470 ohms ±10%, 1/2 W | |
| A3R28 | 0687-1521 | R: fxd, comp, 1500 ohms ±10%, 1/2 W | |
| A3R29 | 0757-0745 | R: fxd, met flm, 4.32K ohms ±1%, 1/4 W | |
| A3R30 | 0757-0339 | R: fxd, met flm, 3.01K ohms ±1%, 1/4 W | |
| A3R31 | 2100-0909 | R: var, comp, lin, 100 ohms ±30%, 1/4 W | |
| A3R32 | 0757-0339 | R: fxd, met flm, 3.01K ohms ±1%, 1/4 W | |
| A3R33 | 0757-0761 | R: fxd, met flm, 22.1K ohms ±1%, 1/4 W | |
| A3R34 | 2100-0908 | R: var, comp, lin, 2K ±30%, 1/4 W | |
| A3R35 | 0757-0761 | R: fxd, met flm, 22.1K ohms ±1%, 1/4 W | |
| A3R36 | 0757-1040 | R: fxd, met flm, 50 ohms ±1%, 1/4 W | |
| A3R37 | 0757-0339 | R: fxd, met flm, 3.01K ohms ±1%, 1/4 W | |
| A3R38 | 0757-1040 | R: fxd, met flm, 50 ohms ±1%, 1/4 W | |
| A3R39 | 0757-0339 | R: fxd, met flm, 3.01K ohms ±1%, 1/4 W | |
| A3T1, A3T2 | 00203-86005 | Transformer, driver Can Be Subbed BY mini-circuits T2-1T | |
| A3T3, A3T4 | 00203-86004 | Transformer, driver | |
| A4 | 00203-66511 | Board ass'y, filter, includes:<br>C1 thru C3 R1, R2<br>L1 thru L3 | |
| A4C1, A4C2 | 0140-0225 | C: fxd, dipped mica, 300 pf ±1%, 300 vdcw | |
| A4C3 | 0140-0195 | C: fxd, dipped mica, 130 pf ±5%, 300 vdcw | |
| A4L1 thru A4L3 | 00203-86006 | Coil, fxd, 4.5 mh | |
| A4R1 | 0757-0744 | R: fxd, met flm, 3.92K ohms ±1%, 1/4 W | |
| A4R2 | 2100-0282 | R: var, lin, ww, 2000 ohms ±20%, 1-1/2 W | |
| A5 | 00203-66511 | All components same as A4 | |
| A6 | 00203-66504 | Board ass'y, dc amplifier, includes:<br>C1 thru C9 R1 thru R22<br>Q1 thru Q5 | |
| A6C1 | 0150-0012 | C: fxd, cer, 0.01 μf ±20%, 1000 vdcw | |
| A6C2 | 0150-0096 | C: fxd, cer, 0.05 μfd +80% -20%, 100 vdcw | |
| A6C3 | 0150-0015 | C: fxd, $TiO_2$, 2.2 pf ±10%, 500 vdcw | |
| A6C4 | 0140-0206 | C: fxd, dipped mica, 270 pf ±5% | |
| A6C5 | 0150-0012 | C: fxd, cer, 0.01 μf ±20%, 1000 vdcw | |
| A6C6 | | Not assigned | |
| A6C7 | 0140-0151 | C: fxd, dipped mica, 820 pf ±2%, 300 vdcw | |
| A6C8 | 0150-0012 | C: fxd, cer, 0.01 μf ±20%, 1000 vdcw | |
| A6C9 | 0150-0047 | C: fxd, $TiO_2$, 6.8 pf ±10%, 500 vdcw | |

# See introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

| REFERENCE DESIGNATION | ⓗ STOCK NO. | DESCRIPTION | NOTE |
|---|---|---|---|
| A6Q1A, B | 1854-0014 | Transistor, silicon, dual NPN silicon, special | |
| A6Q2 | 1854-0033 | Transistor, EIA type 2N3391, NPN silicon | |
| A6Q3, A6Q4 | 1853-0008 | Transistor, EIA type 2N3250, PNP silicon | |
| A6Q5 | 1854-0039 | Transistor, EIA type, 2N3053, NPN silicon | |
| | 1205-0033 | Heat sink, semiconductor (A6Q5) | |
| A6R1 | 0757-0762 | R: fxd, met flm, 24.3K ohms ±1%, 1/4 W | |
| A6R2 | 0757-0768 | R: fxd, met flm, 47.5K ohms ±1%, 1/4 W | |
| A6R3 | 0757-0755 | R: fxd, met flm, 12.1K ohms ±1%, 1/4 W | |
| A6R4 | 0757-0772 | R: fxd, met flm, 68.1K ohms ±1%, 1/4 W | |
| A6R5 | 0757-0771 | R: fxd, met flm, 61.9K ohms ±1%, 1/4 W | |
| A6R6 | 0757-0777 | R: fxd, met flm, 121K ohms ±1%, 1/4 W | |
| A6R7 | 0687-1061 | R: fxd, comp, 10M ohms ±10%, 1/2 W | |
| A6R8 | 2100-0094 | R: var, lin, comp, 50K ohms, 30%, 1/5 W | |
| A6R9 | 0687-4731 | R: fxd, comp, 46K ohms ±10%, 1/2 W | |
| A6R10 | 0687-2721 | R: fxd, comp, 2700 ohms ±10%, 1/2 W | |
| A6R11 | 0687-8221 | R: fxd, comp, 8200 ohms ±10%, 1/2 W | |
| A6R12, A6R13 | 0687-8211 | R: fxd, comp, 820 ohms ±10%, 1/2 W | |
| A6R14, A6R15 | 0687-1011 | R: fxd, comp, 100 ohms ±10%, 1/2 W | |
| A6R16 | 0687-1021 | R: fxd, comp, 1000 ohms ±10%, 1/2 W | |
| A6R17 | 0687-4711 | R: fxd, comp, 470 ohms ±10%, 1/2 W | |
| A6R18 | 0699-0001 | R: fxd, comp, 2.7 ohms ±10%, 1/2 W | |
| A6R19 | 0757-0766 | R: fxd, met flm, 39.2K ohms ±1%, 1/4 W | |
| A6R20 | 2100-0282 | R: var, lin, ww, 2000 ohms ±20%, 1-1/2 W | |
| A6R21 | 0757-0743 | R: fxd, met flm, 3.32K ohms ±1%, 1/4 W | |
| A6R22 | 0757-0728 | R: fxd, met flm, 619 ohms ±1%, 1/4 W | |
| A7 | 00203-66504 | All components same as A6 | |
| A8 | 00203-66502 | Board ass'y, square wave, includes:<br>C1 thru C4 Q1 thru Q5<br>CR1 R1 thru R12<br>L1, L2 | |
| A8C1 | 0180-0105 | C: fxd, Al elect, 50 µf -10% +100%, 25 vdcw | |
| A8C2 | 0180-0050 | C: fxd, Al elect, 40 µf -15% +100%, 50 vdcw | |
| A8C3* | 0140-0039 | C: fxd, dipped mica, 47 pf ±5%, 500 vdcw | |
| A8C4 | 0180-0105 | C: fxd, Al elect, 50 µf -10% +100%, 25 vdcw | |
| A8CR1 | 1901-0025 | Diode, silicon, 50 MA at +1 v, 100 PIV, 12 pf | |
| A8L1, A8L2 | 9140-0029 | Coil, R. F. choke, universal wound, unshielded, 100 µh, 2.6 ohms | |
| A8Q1 | 1854-0033 | Transistor, EIA type 2N3391, NPN silicon | |
| A8Q2, A8Q3 | 1850-0040 | Transistor, PNP germanium | |
| A8Q4, A8Q5 | 1854-0039 | Transistor, EIA type 2N3053, NPN silicon | |
| A8R1, A8R2 | 0687-1031 | R: fxd, comp, 10K ohms ±10%, 1/2 W | |
| A8R3 | 0687-1531 | R: fxd, comp, 15K ohms ±10%, 1/2 W | |
| A8R4 | 0757-0744 | R: fxd, met flm, 3.92K ohms ±1%, 1/4 W | |
| A8R5 | 0757-0740 | R: fxd, met flm, 2.21K ohms ±1%, 1/4 W | |
| A8R6 | 0687-1031 | R: fxd, comp, 10K ohms ±10%, 1/2 W | |
| A8R7 | 0757-0741 | R: fxd, met flm, 2.43K ohms ±1%, 1/4 W | |
| A8R8 | 0757-1050 | R: fxd, met flm, 150 ohms ±1%, 1/2 W | |

*Average value shown, optimum value selected at factory

# See introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

| REFERENCE DESIGNATION | ® STOCK NO. | DESCRIPTION | NOTE |
|---|---|---|---|
| A8R9 | 2100-0206 | R: var, lin, ww, 50 ohms ±10%, 1 W | |
| A8R10 | 0758-0041 | R: fxd, met flm, 91 ohms ±5%, 1/2 W | |
| A8R11 | 0757-1027 | R: fxd, met flm, 680 ohms ±1%, 1/4 W | |
| A8R12 | 0757-0737 | R: fxd, met flm, 1.62K ohms ±1%, 1/4 W | |
| A9 | 00203-66502 | All components same as A8 | |
| A10 | 00203-66508 | Board ass'y, V. F. O., includes:<br>C1 thru C12 Q1 thru Q3<br>CR1 R1 thru R10<br>L1, L2 | |
| A10C1 | 0140-0156 | C: fxd, dipped mica, 1500 pf ±2%, 300 vdcw | |
| A10C2 | 0140-0182 | C: fxd, dipped mica, 5000 pf ±2%, 300 vdcw | |
| A10C3* | | Not assigned | |
| A10C4 | 0150-0096 | C: fxd, cer, 0.05 μfd +80% -20%, 100 vdcw | |
| A10C5 | 0140-0220 | C: fxd, dipped mica, 200 pf ±1%, 300 vdcw | |
| A10C6 | 0150-0096 | C: fxd, cer, 0.05 μfd +80% -20%, 100 vdcw | |
| A10C7 | 0140-0178 | C: fxd, dipped mica, 560 pf ±2%, 300 vdcw | |
| A10C8 | 0150-0071 | C: fxd, cer, 400 pf ±5%, 500 vdcw | |
| A10C9 | 0150-0096 | C: fxd, cer, 0.05 μfd +80% -20%, 100 vdcw | |
| A10C10 | 0140-0153 | C: fxd, mica, 1269 pf ±1%, 300 vdcw | |
| A10C11 | 0140-0170 | C: fxd, dipped mica, 5600 pf ±5%, 300 vdcw | |
| A10C12 | 0140-0217 | C: fxd, dipped mica, 140 pf ±2%, 300 vdcw | |
| A10CR1 | 1901-0040 | Diode, silicon, 30 MA at +1 v, 30 PIV, 2 pf, 2 ns | |
| A10L1 | 9140-0041 | Coil, R. F., 2.5 mh ±10% | |
| A10L2 | 9140-0029 | Coil, R. F. choke, universal wound, unshielded, 100 μh, 2.6 ohms | |
| A10Q1 | 1854-0033 | Transistor, EIA type 2N3391, NPN silicon | |
| A10Q2, A10Q3 | 1854-0005 | Transistor, EIA type 2N708, NPN silicon planar | |
| A10R1 | 0758-0017 | R: fxd, met flm, 1500 ohms ±5%, 1/2 W | |
| A10R2 | 0757-0768 | R: fxd, met flm, 47.5K ohms ±1%, 1/4 W | |
| A10R3 | 0757-0774 | R: fxd, met flm, 82.5K ohms ±1%, 1/4 W | |
| A10R4 | 0757-0738 | R: fxd, met flm, 1.82K ohms ±1%, 1/4 W | |
| A10R5 | 0757-0757 | R: fxd, met flm, 15K ohms ±1%, 1/4 W | |
| A10R6 | 0757-0759 | R: fxd, met flm, 18.2K ohms ±1%, 1/4 W | |
| A10R7 | 0686-6225 | R: fxd, comp, 6200 ohms ±5%, 1/2 W | |
| A10R8 | 0757-0740 | R: fxd, met flm, 2.21K ohms ±1%, 1/4 W | |
| A10R9 | 0687-1031 | R: fxd, comp, 10K ohms ±10%, 1/2 W | |
| A10R10 | 0687-1041 | Not assigned. | |
| A11 | 00203-66501 | Board ass'y, decade module, includes:<br>C1 thru C17 Q1 thru Q3<br>CR1 thru CR3 R1 thru R11<br>L1, L2 T1, T2 | |
| A11C1, A11C2 | 0150-0096 | C: fxd, cer, 0.05 μfd +80% -20%, 100 vdcw | |
| A11C3 | 0140-0145 | C: fxd, dipped mica, 22 pf ±5% | |
| A11C4, A11C5 | 0140-0198 | C: fxd, dipped mica, 200 pf ±5%, 300 vdcw | |
| A11C6, A11C7 | 0140-0156 | C: fxd, dipped mica, 1500 pf ±2%, 300 vdcw | |
| A11C8 | 0150-0093 | C: fxd, 0.01 μf +80% -20%, 100 vdcw | |

*Average value shown, optimum value selected at factory

# See introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

| REFERENCE DESIGNATION | ⓗ STOCK NO. | DESCRIPTION | NOTE |
|---|---|---|---|
| A11C9 | 0140-0224 | C: fxd, dipped mica, 280 pf ±1%, 300 vdcw | |
| A11C10 | 0140-0151 | C: fxd, dipped mica, 820 pf ±2%, 300 vdcw | |
| A11C11 | 0160-0179 | C: fxd, dipped mica, 33 pf ±5%, 300 vdcw | |
| A11C12 | 0140-0192 | C: fxd, dipped mica, 68 pf ±5%, 300 vdcw | |
| A11C13 | 0140-0218 | C: fxd, dipped mica, 160 pf ±2%, 300 vdcw | |
| A11C14 | 0140-0152 | C: fxd, mica, 1000 pf ±5%, 300 vdcw | |
| A11C15 | 0140-0154 | C: fxd, dipped mica, 1300 pf ±5%, 500 vdcw | |
| A11C16 | 0150-0093 | C: fxd, 0.01 µf +80% -20%, 100 vdcw | |
| A11C17 | 0140-0195 | C: fxd, dipped mica, 130 pf ±5%, 300 vdcw | |
| A11CR1, A11CR2 | 1910-0016 | Diode, germanium, 100 MA at +0.85 v, 60 v working | |
| A11CR3 | 1901-0040 | Diode, silicon, 30 MA at +1 v, 30 PIV, 2 pf, 2 ns | |
| A11L1 | 00203-86001 | Coil, var | |
| A11L2 | 00203-86002 | Coil, var | |
| A11Q1 thru A11Q3 | 1854-0005 | Transistor, EIA type 2N708, NPN silicon planar | |
| A11R1 | 0687-1021 | R: fxd, comp, 1000 ohms ±10%, 1/2 W | |
| A11R2 thru A11R4 | 0687-4721 | R: fxd, comp, 4700 ohms ±10%, 1/2 W | |
| A11R5, A11R6 | 0757-0761 | R: fxd, met flm, 22.1K ohms ±1%, 1/4 W | |
| A11R7 | 0687-1031 | R: fxd, comp, 10K ohms ±10%, 1/2 W | |
| A11R8 | 0687-4721 | R: fxd, comp, 4700 ohms ±10%, 1/2 W | |
| A11R9 | 0687-2221 | R: fxd, comp, 2200 ohms ±10%, 1/2 W | |
| A11R10 | 0687-1031 | R: fxd, comp, 10K ohms ±10%, 1/2 W | |
| A11R11 | 0687-1051 | R: fxd, comp, 1M ohms ±10%, 1/2 W | |
| A11T1 | 00203-84202 | Transformer, tuned | |
| A11T2 | 00203-84201 | Transformer, tuned | |
| A12 thru A16 | 00203-66501 | All components same as A11 | |
| A17, A18 | | Optional | |
| A19, A20 | | Not assigned | |
| A21 | 00203-66510 | Board ass'y, rectifier, includes: C1, C2; R1; CR1 thru CR4 | |
| A21C1 | 0130-0017 | C: var, cer, 8 - 50 pf | |
| A21C2* | 0140-0054 | C: fxd, cer, 100 pf ±5%, 500 vdcw | |
| A21CR1 thru A21CR4 | 1901-0028 | Diode, silicon, rectifier, 400 PIV, 0.75 amp | |
| A21R1 | 0761-0022 | R: fxd, met oxide flm, 620 ohms ±5%, 1 W | |
| A22 | 00203-66505 | Board ass'y, power supply, includes: C1 thru C15; Q1 thru Q6; CR1 thru CR5; R1 thru R21 | |
| A22C1 | | Not assigned | |
| A22C2* | 0160-0127 | C: fxd, cer, 1.0 µf ±20%, 25 vdcw | |

*Average value shown, optimum value selected at factory

# See introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

| REFERENCE DESIGNATION | ⓗ STOCK NO. | DESCRIPTION | NOTE |
|---|---|---|---|
| A22C3 | 0180-0114 | C: fxd, Al elect, 4 µf +100% -10%, 25 vdcw | |
| A22C4 | 0180-0039 | C: fxd, elect, 100 µf, 12 vdcw | |
| A22C5 | 0180-0050 | C: fxd, Al elect, 40 µf -15% +100%, 50 vdcw | |
| A22C6 | 0150-0096 | C: fxd, cer, 0.05 µfd, +80% -20%, 100 vdcw | |
| A22C7 | 0180-0224 | C: fxd, Al elect, 10 µf -10% +75%, 15 vdcw | |
| A22C8 | 0180-0105 | C: fxd, Al elect, 50 µf -10% +100%, 25 vdcw | |
| A22C9 | 0180-0094 | C: fxd, Al elect, 100 µf -10% +100%, 25 vdcw | |
| A22C10 | 0150-0096 | C: fxd, cer, 0.05 µfd +80% -20%, 100 vdcw | |
| A22C11 | 0160-0127 | C: fxd, cer, 1.0 µf ±20%, 25 vdcw | |
| A22C12* | 0150-0096 | C: fxd, cer, 0.05 µfd +80% -20%, 100 vdcw | |
| A22C13 | 0180-0105 | C: fxd, Al elect, 50 µf -10% +100%, 25 vdcw | |
| A22C14 | 0150-0096 | C: fxd, cer, 0.05 µfd +80% -20%, 100 vdcw | |
| A22C15 | 0180-0094 | C: fxd, Al elect, 100 µf -10% +100%, 25 vdcw | |
| A22CR | 1902-0761 | Diode, breakdown, EIA type 1N821, 5.9 to 6.5 v | |
| A22CR2, A22CR3 | 1901-0025 | Diode, silicon, 50 MA at +1 v, 100 PIV, 12 pf | |
| A22CR4, A22CR5 | 1901-0028 | Diode, silicon, rectifier, 400 PIV, 0.75 amp | |
| A22Q1 | 1854-0039 | Transistor, EIA type 2N3053, NPN silicon | |
| A22Q2 thru A22Q4 | 1850-0040 | Transistor, PNP germanium | |
| A22Q5 | 1854-0039 | Transistor, EIA type 2N3053, NPN silicon | |
| A22Q6 | 1851-0017 | Transistor, EIA type 2N1304, NPN germanium | |
| A22R1, A22R2 | 0687-4721 | R: fxd, comp, 4700 ohms ±10%, 1/2 W | |
| A22R3 | 0699-0002 | R: fxd, comp, 6.8 ohms ±10%, 1/2 W | |
| A22R4 | 0757-0732 | R: fxd, met flm, 909 ohms ±1%, 1/4 W | |
| A22R5 | 0757-0736 | R: fxd, met flm, 1.5K ohms ±1%, 1/4 W | |
| A22R6 | 0687-2231 | R: fxd, comp, 22K ohms ±10%, 1/2 W | |
| A22R7 | 0687-2711 | R: fxd, comp, 270 ohms ±10%, 1/2 W | |
| A22R8 | 0687-1821 | R: fxd, comp, 1800 ohms ±10%, 1/2 W | |
| A22R9 | 0757-0734 | R: fxd, met flm, 1.21K ohms ±1%, 1/4 W | |
| A22R10 | 0687-1011 | R: fxd, comp, 100 ohms ±10%, 1/2 W | |
| A22R11 | 0757-0724 | R: fxd, met flm, 392 ohms ±1%, 1/4 W | |
| A22R12 | 2100-0281 | R: var, lin, ww, 100 ohms ±20%, 1-1/2 W | |
| A22R13 | 0757-1033 | R: fxd, met flm, 200 ohms ±0.5%, 1/4 W | |
| A22R14 | 0757-0730 | R: fxd, met flm, 750 ohms ±1%, 1/4 W | |
| A22R15 | 0687-3311 | R: fxd, comp, 330 ohms ±10%, 1/2 W | |
| A22R16 | 0687-1531 | R: fxd, comp, 15K ohms ±10%, 1/2 W | |
| A22R17 | -687-4721 | R: fxd, comp, 4700 ohms ±10%, 1/2 W | |
| A22R18 | 0687-1531 | R: fxd, comp, 15K ohms ±10%, 1/2 W | |
| A22R19 | 0687-1011 | R: fxd, comp, 100 ohms ±10%, 1/2 W | |
| A22R20 | 2100-0281 | R: var, lin, ww, 100 ohms ±20%, 1-1/2 W | |
| A22R21 | 0757-0730 | R: fxd, met flm, 750 ohms ±1%, 1/4 W | |
| A23, A24 | | Not assigned | |
| A25 | 00203-64201 | Phase shifter, includes: C1 thru C3 | |
| A25C1 | 0130-0015 | C: var, cer, 9-50 pf | |
| A25C2, A25C3 | 0160-3132 | C: fxd, cer, 200 pf ±10%, 500 vdcw | |
| C1, C2 | 0180-0056 | C: fxd, elect, 1000 µf, 50 vdcw | |
| C3 | 0170-0022 | C: fxd, mylar, 0.1 µf ±20%, 600 vdcw | |

*Average value shown, optimum value selected at factory

# See introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

| REFERENCE DESIGNATION | ⓗ STOCK NO. | DESCRIPTION | NOTE |
|---|---|---|---|
| C4 | 0160-0151 | C: fxd, cer, 4700pf -20% +80% 4000vdcw | |
| C5 | 0160-0151 | C: fxd, cer, 4700pf -20% +80% 4000vdcw | |
| C6 thru C10 | | Not assigned | |
| C11 | 0121-0117 | C: var, air, 12.5 to 86.9 pf | |
| C12* | 0160-0378 | C: fxd, dipped mica, 27 pf ±5%, 500 vdcw | |
| C13 | 0160-0905 | C: fxd, cer, 33 pf ±2%, 600 vdcw | |
| C14 | 0140-0225 | C: fxd, dipped mica, 300 pf ±1%, 300 vdcw | |
| C15 | 0121-0007 | C: var, air, 3.6 pf to 26 pf, single sect | |
| DS1 | 2140-0058 | Lamp, incandescent, 10 v at 0.040 amps | |
| F1 | 2110-0202 | Fuse, 500mA for 230V operation | |
| | 2110-0312 | Fuse, 1A for 115V operation | |
| J1 | 1251-0148 | Connector, power, receptacle, 3 pin male recessed chassis mounting | |
| J2 thru J5 | 0340-0086 | Insulator, BP double, without locating key | |
| | 0340-0090 | Insulator, BP, with locating key | |
| | 1510-0006 | Binding post, black, without solder turret | |
| | 1510-0007 | Binding post, red, without solder turret | |
| L1 | 9140-0231 | Coil, adjustable, inductance, 10.8 to 18.7 µh | |
| L2 | 9140-0230 | Coil, fxd, inductance, 290 µh ±1% | |
| L3, L4 | 9140-0115 | Coil, fxd R. F., 22 µh ±10% | |
| MP1 | 1500-0002 | Yoke, coupler, for 1/4" shaft, p/o flexible coupler, keyed and staked | |
| MP2 | 5040-0212 | Insulator, flex coupling | |
| MP3 | 5060-0021 | Gear, ass'y | |
| MP4 | 5000-0637 | Spring, thrust, vernier drive | |
| MP5 | 5060-0020 | Gear, ass'y, with coupling hub | |
| MP6 | 5020-0233 | Collar and stop, dial hub | |
| MP7 | 5020-0345 | Shaft, pin dowel | |
| MP8 | 5020-0641 | Shaft, spur gear | |
| MP9 | 5020-0639 | Bearing, cap drive machine casting | |
| MP10 | 5020-0630 | Hub, dial | |
| MP11 | 5040-0607 | Disc ass'y, vernier drive | |
| Q1, Q2 | 1850-0038 | Transistor, 2N301, PNP, germanium | |
| Q3 | 1850-0095 | Transistor type 2N297A power, PNP germanium | |
| R1 | 0761-0054 | R: fxd, met flm, 330 ohms ±5%, 1 W | |
| R2, R3 | 0768-0001 | R: fxd, met, 1000 ohms ±10%, 3 W | |
| R4, R5 | 0764-0063 | R: fxd, met flm, 620 ohms ±5%, 2 W | |
| R6 | 2100-0113 | R: var, comp, dual tandem, 2 W | |
| R7, R8 | 0757-0728 | R: fxd, met flm, 619 ohms ±1%, 1/4 W | |
| R9 | 2100-0113 | R: var, comp, dual tandem, 2 W | |
| R10, R11 | 0757-0728 | R: fxd, met flm, 619 ohms ±1%, 1/4 W | |
| R12 | 2100-0113 | R: var, comp, dual tandem, 2 W | |
| R13, R14 | 0757-0728 | R: fxd, met flm, 619 ohms ±1%, 1/4 W | |
| R15 | 2100-0113 | R: var, comp, dual tandem, 2 W | |
| R16, R17 | 0757-0728 | R: fxd; met flm, 619 ohms ±1%, 1/4 W | |
| S1A, B, C | 3100-0841 | Switch, multiplier | |
| S1C1, S1C2 | 0160-0170 | C: fxd, cer, 0.22 µf +80% -20%, 25 vdcw | |
| S2 | 3101-1248 | Switch, pushbutton | |
| S3 | 3101-1234 | Switch, slide | |
| T1 | 9100-0293 | Transformer, power | |
| W1 | 8120-1348 | Cable ass'y, power | |

# See introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

| REFERENCE DESIGNATION | ⓗ STOCK NO. | DESCRIPTION | NOTE |
|---|---|---|---|
| | | MISCELLANEOUS | |
| | 61B-40D-4 | Plate, freq, dial | |
| | 120A-47A | Spacer, binding post | |
| | 0340-0090 | Insulator, BP, with locating key | |
| | 0370-0025 | Knob, amplitude and frequency vernier | |
| | 0370-0112 | Knob, skirted bar, black, for 1/4" diam shaft (multiplier) | |
| | 0370-0160 | Knob (frequency dial) | |
| | 1200-0043 | Insulator, transistor, mtg, anodized Al plate (Q1, Q2, Q3) | |
| | 1200-0081 | Insulator, bushing nylon (Q1, Q2, Q3) | |
| | 1251-0135 | Connector, printed circuit, 15 tuning fork type contacts, terminal type B | |
| | 1251-2357 | Connector, power, receptacle, 3 pin male | |
| | 1251-1031 | Connector, printed circuit, 6 tuning fork type contacts, terminal 1, style d; 2 thru 6, style b | |
| | 1251-0475 | Connector, printed circuit, 6 tuning fork type contacts, terminal type B | |
| | 1400-0084 | Body, fuseholder | |
| | 1410-0052 | Bushing, cal adjust potentiometer, 0.435" OD x 0.438" lg | |
| | 1460-0114 | Spring, gear assembly | |
| | 1490-0030 | Stand, tilt, stainless steel rod 0.188" diam | |
| | 1500-0004 | Coupler, cal adjust insulator, 1/2" diam x 7/32" lg, nylon | |
| | 1500-0005 | Coupler, cal adjust hub, fits 1/4" diam shaft, nickel plated | |
| | 1510-0006 | Binding Post, black, without solder turret | |
| | 1510-0007 | Binding Post, red, without solder turret | |
| | 1520-0001 | Plate, mounting, bakelite, oval shape (C1, C2) | |
| | 5000-0051 | Plate, fluted Al | |
| | 5000-0732 | Rear side cover, 5 x 11 FM | |
| | 5000-0733 | Front side cover, 5 x 11 FM | |
| | 5020-0241 | Support, long res bd | |
| | 5040-0619 | Indicator, freq dial | |
| | 5060-0222 | Handle ass'y, side | |
| | 5060-0625 | Ass'y, connector | |
| | 5060-0731 | Frame ass'y, 5 x 11 FM | |
| | 5060-0739 | Top cover ass'y, 11L FM | |
| | 5060-0751 | Bottom cover ass'y, 11L FM | |
| | 5060-0766 | Retainer, 5H handle | |
| | 5060-0767 | Foot ass'y, FM | |
| | 9211-0248 | Carton, corrugated, 20-1/8" lg x 16-3/4" wd x 10-1/2" deep x 350 lb test | |
| | 9223-0040 | Foam, poly, 10-3/4" lg x 4" wd | |
| | 00203-00101 | Chassis, main | |
| | 00203-00211 | Panel, front | |
| | 00203-00212 | Panel, rear | |
| | | ADDITIONAL PARTS FOR 203A OPTION:01 | |
| A17 | 00203-00213 | Panel, front | |
| | 00203-66501 | Board, decade module | |
| | | ADDITIONAL PARTS FOR 203A OPTION:02 | |
| A17, A18 | 00203-00214 | Panel, front | |
| | 00203-66501 | Board, decade module | |

# See introduction to this section

Table 6-2. Replaceable Parts

| ℎ𝑝 Stock No. | Description | Mfr. | Mfr. Part No. | TQ | | |
|---|---|---|---|---|---|---|
| 61B-40D-4 | Plate, freq dial | 28480 | 61B-40D-4 | 1 | | |
| 120A-47A | Spacer, binding post | 28480 | 120A-47A | 1 | | |
| 0121-0007 | C: var, air, 3.6 pf to 26 pf, single sect | 80486 | CT2-0-25L | 1 | | |
| 0121-0117 | C: var, air, 12.5 to 86.9 pf | 77630 | 882758 | 1 | | |
| 0130-0015 | C: var, cer, 9-50 pf | 72982 | 3192-000-U2PO-47R | 1 | | |
| 0130-0017 | C: var, cer, 8-50 pf | 72982 | 557-019-U2PO-34R | 1 | | |
| 0131-0003 | C: var, mica, single sect, 170 - 180 pf, 175 vdcw | 72136 | T52910 | 1 | | |
| 0140-0054 | C: fxd, molded mica, 10 pf ±10% | 04062 | RCM15E101K | 1 | | |
| 0140-0145 | C: fxd, dipped mica, 22 pf ±5% | 04062 | RDM15C220J5C | 9 | | |
| 0140-0151 | C: fxd, dipped mica, 820 pf ±2%, 300 vdcw | 14655 | obd# | 9 | | |
| 0140-0152 | C: fxd, mica, 1000 pf ±5%, 300 vdcw | 04062 | DM16F102J | 10 | | |
| 0140-0153 | C: fxd, mica, 1269 pf ±1%, 300 vdcw | 14655 | CD20F1269F | 2 | | |
| 0140-0154 | C: fxd, dipped mica, 1300 pf ±5%, 500 vdcw | 14655 | obd# | 8 | | |
| 0140-0156 | C: fxd, dipped mica, 1500 pf ±2%, 300 vdcw | 00853 | obd# | 13 | | |
| 0140-0157 | C: fxd, dipped mica, 1857 pf ±1%, 500 vdcw | 14655 | obd# | 1 | | |
| 0140-0161 | C: fxd, dipped mica, 3932 pf ±1%, 300 vdcw | 14655 | obd# | 2 | | |
| 0140-0170 | C: fxd, dipped mica, 5600 pf ±5%, 300 vdcw | 00853 | obd# | 1 | | |
| 0140-0176 | C: fxd, dipped mica, 100 pf ±2%, 300 vdcw | 00853 | obd# | 1 | | |
| 0140-0178 | C: fxd, dipped mica, 560 pf ±2%, 300 vdcw | 00853 | obd# | 3 | | |
| 0140-0182 | C: fxd, dipped mica, 5000 pf ±2%, 300 vdcw | 00853 | obd# | 1 | | |
| 0140-0192 | C: fxd, dipped mica, 68 pf ±5%, 300 vdcw | 00853 | obd# | 6 | | |
| 0140-0195 | C: fxd, dipped mica, 130 pf ±5%, 300 vdcw | 00853 | obd# | 12 | | |
| 0140-0198 | C: fxd, dipped mica, 200 pf ±5%, 300 vdcw | 00853 | obd# | 12 | | |
| 0140-0201 | C: fxd, dipped mica, 12 pf ±5%, 500 vdcw | 00853 | obd# | 1 | | |
| 0140-0204 | C: fxd, dipped mica, 47 pf ±5%, 500 vdcw | 00853 | obd# | 1 | | |
| 0140-0206 | C: fxd, dipped mica, 270 pf ±5%, 500 vdcw | 00853 | obd# | 2 | | |
| 0140-0207 | C: fxd, dipped mica, 330 pf ±5%, 500 vdcw | 00853 | obd# | 1 | | |
| 0140-0208 | C: fxd, dipped mica, 680 pf ±5%, 300 vdcw | 00853 | obd# | 1 | | |
| 0140-0217 | C: fxd, dipped mica, 140 pf ±2%, 300 vdcw | 14655 | obd# | 2 | | |
| 0140-0218 | C: fxd, dipped mica, 160 pf ±2%, 300 vdcw | 00853 | obd# | 6 | | |
| 0140-0220 | C: fxd, dipped mica, 200 pf ±1%, 300 vdcw | 00853 | obd# | 1 | | |
| 0140-0224 | C: fxd, dipped mica, 280 pf ±1%, 300 vdcw | 00853 | obd# | 6 | | |
| 0140-0225 | C: fxd, dipped mica, 300 pf ±1%, 300 vdcw | 14655 | obd# | 5 | | |
| 0150-0012 | C: fxd, cer, 0.01 μf ±20%, 1000 vdcw | 71590 | 13 C Disc | 9 | | |
| 0150-0015 | C: fxd, $TiO_2$, 2.2 pf ±10%, 500 vdcw | 82142 | type JM | 2 | | |
| 0150-0047 | C: fxd, $TiO_2$, 6.8 pf ±10%, 500 vdcw | 82142 | type JM obd# | 2 | | |
| 0150-0069 | C: fxd, cer, 0.001 μf +100% -20%, 500 vdcw | 72982 | #801-010x5G0102Z | 1 | | |
| 0150-0071 | C: fxd, cer, 400 pf ±5%, 500 vdcw | 56289 | 19C formulation 28 | 3 | | |
| 0150-0093 | C: fxd, 0.01 μf +80% -20%, 100 vdcw | 91418 | TA obd# | 14 | | |
| 0150-0096* | C: fxd, cer, 0.05 μfd +80% -20%, 100 vdcw | 94145 | type TA | 34 | | |
| 0150-0115 | C: fxd, cer, 27 pf ±10%, 500 vdcw | 72982 | 301-000-U2JO-270K | 1 | | |
| 0160-0127* | C: fxd, cer, 1.0 μf ±20%, 25 vdcw | 56289 | 5C13 | 4 | | |
| 0160-0147 | C: fxd, dipped mica, 2500 pf ±2%, 300vdcw | 00853 | obd# | 1 | | |
| 0160-0151 | C: fxd, cer, 4700pf -20% +80%, 4000vdcw | | | 2 | | |
| 0160-0170 | C: fxd, cer, 0.22 μf +80% -20%, 25vdcw | 56289 | 5C9A | 2 | | |
| 0160-0174 | C: fxd, cer, 0.47 μf +80% -20%, 25vdcw | 56289 | 5C11A | 8 | | |
| 0160-0179 | C: fxd, dipped mica, 33pf ±5%, 300vdcw | 00853 | obd# | 6 | | |

* Average value shown, optimum value selected at factory
\# See introduction to this section

Table 6-2. Replaceable Parts (Cont'd)

| ⓗ Stock No. | Description | Mfr. | Mfr. Part No. | TQ | | |
|---|---|---|---|---|---|---|
| 0160-0182 | C: fxd, dipped mica, 47 pf ±5%, 300 vdcw | 00853 | obd# | 1 | | |
| 0160-0217 | C: fxd, dipped mica, 2300 pf ±1% | 04062 | RDM20F232F3C | 1 | | |
| 0160-3132 | C: fxd, cer, 200 pf ±10%, 500 vdcw | 71590 | Type CC32, TCN-200 | 4 | | |
| 0160-0905 | C: fxd, cer, 33 pf ±2%, 600 vdcw | 71590 | CC20 33pf ±2% N750 | 1 | | |
| 0170-0022 | C: fxd, mylar, 0.1 µf ±20%, 600 vdcw | 56289 | 148P175A | 1 | | |
| 0180-0039 | C: fxd, elect, 100 µf, 12 vdcw | 56289 | D32697 | 1 | | |
| 0180-0050 | C: fxd, Al elect, 40 µf -15% +100%, 50 vdcw | 56289 | D32538 | 3 | | |
| 0180-0056 | C: fxd, elect, 1000 µf, 50 vdcw | 56289 | D32429 | 2 | | |
| 0180-0059 | C: fxd, elect, 10 µf -10% +100%, 25 vdcw | 56289 | 30D106G025BB4 | 2 | | |
| 0180-0094 | C: fxd, Al elect, 100 µf -10% +100%, 25 vdcw | 56289 | 30D107G025DH4 | 2 | | |
| 0180-0105 | C: fxd, Al elect, 50 µf -10% +100%, 25 vdcw | 56289 | D34114 | 6 | | |
| 0180-0114 | C: fxd, Al elect, 4 µf +100% -10%, 25 vdcw | 56289 | 30D405G025BA4 | 1 | | |
| 0180-0224 | C: fxd, Al elect, 10 µf -10% +75%, 15 vdcw | 56289 | 30D106G015BA4 | 1 | | |
| 0340-0086 | Insulator, BP Double, without locating key | 28480 | 0340-0086 | 4 | | |
| 0340-0090 | Insulator, BP, with locating key | 28480 | 0340-0090 | 5 | | |
| 0370-0025 | Knob, amplitude and frequency vernier | 28480 | 0370-0025 | 1 | | |
| 0370-0112 | Knob, skirted bar, black, for 1/4" diam shaft (multiplier) | 28480 | 0370-0112 | 1 | | |
| 0370-0160 | Knob (frequency multiplier) | 28480 | 0370-0160 | 1 | | |
| 0410-0009 | Crystal unit, quartz, 5 mc, 2 pins on bottom | 0000Y | obd# | 1 | | |
| 0683-4715 | R: fxd, comp, 470 ohms, ±5%, 1/4 W | 01121 | CB4715 | 1 | | |
| 0686-6225 | R: fxd, comp, 6200 ohms ±5%, 1/2 W | 01121 | EB-6225 | 1 | | |
| 0687-1011 | R: fxd, comp, 100 ohms ±10%, 1/2 W | 01121 | #EB1011 | 6 | | |
| 0687-1021 | R: fxd, comp, 1000 ohms ±10%, 1/2 W | 01121 | #EB1021 | 9 | | |
| 0687-1031 | R: fxd, comp, 10 K ohms ±10%, 1/2 W | 01121 | #EB1031 | 23 | | |
| 0687-1051 | R: fxd, comp, 1 M ohms ±10%, 1/2 W | 01121 | #EB1051 | 6 | | |
| 0687-1061 | R: fxd, comp, 10 M ohms ±10%, 1/2 W | 01121 | #EB1061 | 2 | | |
| 0687-1231 | R: fxd, comp, 12 K ohms ±10%, 1/2 W | 01121 | #EB1231 | 1 | | |
| 0687-1521 | R: fxd, comp, 1500 ohms ±10%, 1/2 W | 01121 | #EB1521 | 6 | | |
| 0687-1531 | R: fxd, comp, 15 K ohms ±10%, 1/2 W | 01121 | #EB1531 | 4 | | |
| 0687-1821 | R: fxd, comp, 1800 ohms ±10%, 1/2 W | 01121 | #EB1821 | 1 | | |
| 0687-2221 | R: fxd, comp, 2200 ohms ±10%, 1/2 W | 01121 | #EB2221 | 9 | | |
| 0687-2231 | R: fxd, comp, 22 K ohms ±10%, 1/2 W | 01121 | #EB2231 | 1 | | |
| 0687-2711 | R: fxd, comp, 270 ohms ±10%, 1/2 W | 01121 | #EB2711 | 1 | | |
| 0687-2721 | R: fxd, comp, 2700 ohms ±10%, 1/2 W | 01121 | #EB2721 | 2 | | |
| 0687-3311 | R: fxd, comp, 330 ohms ±10%, 1/2 W | 01121 | #EB3311 | 1 | | |
| 0687-3921 | R: fxd, comp, 3900 ohms ±10%, 1/2 W | 01121 | #EB3921 | 1 | | |
| 0687-4701 | R: fxd, comp, 47 ohms ±10%, 1/2 W | 01121 | #EB4701 | 1 | | |
| 0687-4711 | R: fxd, comp, 470 ohms ±10%, 1/2 W | 01121 | #EB4711 | 8 | | |
| 0687-4721 | R: fxd, comp, 4700 ohms ±10%, 1/2 W | 01121 | #EB4721 | 31 | | |
| 0687-4731 | R: fxd, comp, 47 K ohms ±10%, 1/2 W | 01121 | #EB4731 | 4 | | |
| 0687-5621 | R: fxd, comp, 5600 ohms ±10%, 1/2 W | 01121 | #EB5621 | 1 | | |
| 0687-6811 | R: fxd, comp, 680 ohms ±10%, 1/2 W | 01121 | EB6811 | 2 | | |
| 0687-8211 | R: fxd, comp, 820 ohms ±10%, 1/2 W | 01121 | #EB8211 | 4 | | |
| 0687-8221 | R: fxd, comp, 8200 ohms ±10%, 1/2 W | 01121 | #EB8221 | 2 | | |
| 0699-0001 | R: fxd, comp, 2.7 ohms ±10%, 1/2 W | 01121 | EB-27G1 | 2 | | |
| 0699-0002 | R: fxd, comp, 6.8 ohms ±10%, 1/2 W | 01121 | EB 68G1 | 1 | | |
| 0757-0339 | R: fxd, met flm, 3.01 K ohms ±1%, 1/4 W | 19701 | MF6C T-O obd# | 8 | | |
| 0757-0715 | R: fxd, met flm, 150 ohms ±1%, 1/4 W | 75042 | CEB T-O obd# | 2 | | |

# See introduction to this section

Table 6-2. Replaceable Parts (Cont'd)

| ⓗ Stock No. | Description | Mfr. | Mfr. Part No. | TQ | | |
|---|---|---|---|---|---|---|
| 0757-0724 | R: fxd, met flm, 392 ohms ±1%, 1/4 W | 75042 | CEB T-O obd# | 1 | | |
| 0757-0728 | R: fxd, met flm, 619 ohms ±1%, 1/4 W | 75042 | CEB T-O obd# | 10 | | |
| 0757-0730 | R: fxd, met flm, 750 ohms ±1%, 1/4 W | 75042 | CEB T-O obd# | 2 | | |
| 0757-0732 | R: fxd, met flm, 909 ohms ±1%, 1/4 W | 75042 | CEB T-O obd# | 1 | | |
| 0757-0734 | R: fxd, met flm, 1.21 K ohms ±1%, 1/4 W | 75042 | CEB T-O obd# | 1 | | |
| 0757-0736 | R: fxd, met flm, 1.5 K ohms ±1%, 1/4 W | 75042 | CEB T-O obd# | 3 | | |
| 0757-0737 | R: fxd, met flm, 1.62 K ohms ±1%, 1/4 W | 75042 | CEB T-O obd# | 2 | | |
| 0757-0738 | R: fxd, met flm, 1.82 K ohms ±1%, 1/4 W | 75042 | CEB T-O obd# | 1 | | |
| 0757-0740 | R: fxd, met flm, 2.21 K ohms ±1%, 1/4 W | 75042 | CEB T-O obd# | 3 | | |
| 0757-0741 | R: fxd, met flm, 2.43 K ohms ±1%, 1/4 W | 75042 | CEB T-O obd# | 2 | | |
| 0757-0743 | R: fxd, met flm, 3.32 K ohms ±1%, 1/4 W | 75042 | CEB T-O obd# | 4 | | |
| 0757-0744 | R: fxd, met flm, 3.92 K ohms ±1%, 1/4 W | 75042 | CEB T-O obd# | 4 | | |
| 0757-0745 | R: fxd, met flm, 4.32 K ohms ±1%, 1/4 W | 75042 | CEB T-O obd# | 2 | | |
| 0757-0755 | R: fxd, met flm, 12.1 K ohms ±1%, 1/4 W | 75042 | CEB T-O obd# | 2 | | |
| 0757-0757 | R: fxd, met flm, 15 K ohms ±1%, 1/4 W | 75042 | CEB T-O obd# | 1 | | |
| 0757-0759 | R: fxd, met flm, 18.2 K ohms ±1%, 1/4 W | 75042 | CEB T-O obd# | 1 | | |
| 0757-0761 | R: fxd, met flm, 22.1 K ohms ±1%, 1/4 W | 75042 | CEB T-O obd# | 16 | | |
| 0757-0762 | R: fxd, met flm, 24.3 K ohms ±1%, 1/4 W | 75042 | CEB T-O obd# | 2 | | |
| 0757-0766 | R: fxd, met flm, 39.2 K ohms ±1%, 1/4 W | 75042 | CEB T-O obd# | 2 | | |
| 0757-0768 | R: fxd, met flm, 47.5 K ohms ±1%, 1/4 W | 75042 | CEB T-O obd# | 3 | | |
| 0757-0771 | R: fxd, met flm, 61.9 K ohms ±1%, 1/4 W | 75042 | CEB T-O obd# | 2 | | |
| 0757-0772 | R: fxd, met flm, 68.1 K ohms ±1%, 1/4 W | 75042 | CEB T-O obd# | 2 | | |
| 0757-0774 | R: fxd, met flm, 82.5 K ohms ±1%, 1/4 W | 75042 | CEB T-O obd# | 1 | | |
| 0757-0777 | R: fxd, met flm, 121 K ohms ±1%, 1/4 W | 75042 | CEB T-O obd# | 2 | | |
| 0757-1027 | R: fxd, met flm, 680 ohms ±1%, 1/4 W | 75042 | CEB obd# | 2 | | |
| 0757-1032 | R: fxd, met flm, 100 ohms ±0.5%, 1/4 W | 75042 | CEB T-O obd# | 1 | | |
| 0757-1033 | R: fxd, met flm, 200 ohms ±0.5%, 1/4 W | 75042 | CEB T-O obd# | 1 | | |
| 0757-1040 | R: fxd, met flm, 50 ohms ±1%, 1/4 W | 75042 | CEB T-O obd# | 4 | | |
| 0757-1050 | R: fxd, met flm, 150 ohms ±1%, 1/2 W | 19701 | MF7C T-2 | 2 | | |
| 0758-0017 | R: fxd, met flm, 1500 ohms ±5%, 1/2 W | 07115 | C20 | 1 | | |
| 0758-0041 | R: fxd, met flm, 91 ohms ±5%, 1/2 W | 07115 | C20 | 2 | | |
| 0761-0022 | R: fxd, met flm, 620 ohms ±5%, 1 W | 07115 | C32 | 1 | | |
| 0761-0054 | R: fxd, met flm, 330 ohms ±5%, 1 W | 07115 | C32 | 1 | | |
| 0764-0063 | R: fxd, met flm, 620 ohms ±5%, 2 W | 28480 | 0764-0063 | 2 | | |
| 0768-0001 | R: fxd, met, 1000 ohms ±10%, 3 W | 76055 | 3MOL | 2 | | |
| 1200-0043 | Insulator, transistor, mtg, anodized Al plate (Q1, Q2, Q3) | 28480 | 1200-0043 | 3 | | |
| 1200-0081 | Insulator, bushing, nylon (Q1, Q2, Q3) | 26365 | 974 Special | 6 | | |
| 1205-0033 | Heat dissipater, semiconductor (A6Q5) | 28480 | 1205-0033 | 1 | | |
| 1251-0135 | Connector, printed circuit, 15 tuning fork type contacts, terminal type B | 000XX | SD 615 UR | 5 | | |
| 1251-2357 | Connector, power | | | 1 | | |
| 1251-0475 | Connector, printed circuit, 6 tuning fork type contacts, terminal type B | 02660 | 143-006-08(109) | 13 | | |
| 1251-1031 | Connector, printed circuit, 6 tuning fork type contacts, terminal 1, style d; 2 thru 6, style b | 000XX | SD-606UR-TS1 | 1 | | |
| 1400-0084 | Body, fuseholder | | | 1 | | |
| 1410-0052 | Bushing, potentiometer, 0.435" OD x 0.438" lg | 28480 | 1410-0052 | 1 | | |

\# See introduction to this section

Table 6-2. Replaceable Parts (Cont'd)

| ⓗⓟ Stock No. | Description | Mfr. | Mfr. Part No. | TQ | | |
|---|---|---|---|---|---|---|
| 1490-0030 | Stand, tilt, stainless steel rod 0.188" diam | 91260 | obd# | 1 | | |
| 1500-0002 | Yoke, coupler, for 1/4" shaft, p/o flexible coupler, keyed and staked | 76487 | obd# | 2 | | |
| 1500-0004 | Coupler, insulator, 1/2" diam x 7/32" lg, nylon | 99934 | obd# | 1 | | |
| 1500-0005 | Coupler, hub, fits 1/4" diam shaft, nickel plated | 99934 | obd# | 2 | | |
| 1510-0006 | Binding Post, black, without solder turret | 28480 | 1510-0006 | 5 | | |
| 1510-0007 | Binding Post, red, without solder turret | 28480 | 1510-0007 | 5 | | |
| 1520-0001 | Plate, mounting, bakelite, oval shape (C1, C2) | 56137 | Grade XP | 2 | | |
| 1850-0038 | Transistor, 2N301, PNP germanium | 28480 | 1850-0039 | 5 | | |
| 1850-0040 | Transistor, PNP germanium | 28480 | 1850-0040 | 7 | | |
| 1850-0095 | Transistor, type 2N297A power, PNP germanium | 16758 | 2N297A | 1 | | |
| 1851-0017 | Transistor, EIA type 2N1304, NPN germanium | 01295 | 2N1304 | 1 | | |
| 1853-0008 | Transistor, EIA type 2N3250, PNP silicon | 04713 | 2N3250 | 4 | | |
| 1853-0009 | Transistor, PNP silicon | 04713 | SM3197 | 2 | | |
| 1853-0016 | Transistor, 2N3638, PNP silicon | 28480 | 1853-0016 | 5 | | |
| 1854-0005 | Transistor, EIA type 2N708, NPN silicon planar | 86684 | 2N708 | 26 | | |
| 1854-0014 | Transistor, silicon, dual NPN silicon, special | 00872 | SA2015 | 4 | | |
| 1854-0033 | Transistor, EIA type 2N3391, NPN silicon | 24446 | obd# | 16 | | |
| 1854-0039 | Transistor, EIA type 2N3053, NPN silicon | 86684 | 2N2270 | 10 | | |
| 1901-0025 | Diode, silicon, 50 MA at +1 v, 100 PIV, 12 pf | 03877 | SG-817 | 4 | | |
| 1901-0026 | Diode, silicon, rectifier, 200 PIV, 0.5 amp | 14099 | SA783 | 4 | | |
| 1901-0040 | Diode, silicon, 30 MA at +1 v, 30 PIV, 2 pf, 2 ns | 03877 | SG5050 | 11 | | |
| 1901-0049 | Diode, silicon, rectifier, 50 PIV, 0.5 amp | 86684 | 34934 | 2 | | |
| 1902-0761 | Diode, breakdown, EIA type 1N821, 5.9 to 6.5 v, 0.01%/°C | 03877 | 1N821 | 1 | | |
| 1910-0016 | Diode, germanium, 100 MA at +0.85 v, 60 v working | 11711 | GD 150 | 12 | | |
| 2100-0094 | R: var, lin, comp, 50 K ohms, 30%, 1/5 W | 28480 | 2100-0094 | 2 | | |
| 2100-0113 | R: var, comp, 2 W, dual tendem | 01121 | JJ59160 | 4 | | |
| 2100-0206 | R: var, lin, ww, 50 ohms ±10%, 1 W | 11236 | Series 110 | 2 | | |
| 2100-0281 | R: var, lin, ww, 100 ohms ±20%, 1-1/2 W | 11236 | Series 110 | 2 | | |
| 2100-0282 | R: var, lin, ww, 2000 ohms ±20%, 1-1/2 W | 11236 | Series 110 | 5 | | |
| 2100-0908 | R: var, comp, lin, 2 K ±30%, 1/4 W | 76055 | MTC-1 obd# | 2 | | |
| 2100-0909 | R: var, comp, lin, 100 ohms ±30%, 1/4 W | 76055 | MTC-1 obd# | 2 | | |
| 2110-0202 | Fuse, 500mA | | | 1 | | |
| 2110-0312 | Fuse, 1A | | | 1 | | |
| 2140-0058 | Lamp, incandescent, 10v at 0.040 amps | 94154 | 367 | 1 | | |
| 3100-0841 | Switch, Multiplier | 76854 | obd# | 3 | | |
| 3101-1234 | Switch, slide | | | 1 | | |
| 3101-1248 | Switch, pushbutton | | | 1 | | |
| 5000-0051 | Plate, fluted Al | 28480 | 5000-0051 | 1 | | |
| 5000-0637 | Spring, thrust | 28480 | 5000-0637 | 1 | | |
| 5000-8597 | Rear side cover, 5 x 11 FM | 28480 | 5000-8597 | 1 | | |
| 5000-8599 | Front side cover, 5 x 11 FM | 28480 | 5000-8599 | 1 | | |
| 5020-0233 | Collar | 28480 | 5020-0233 | 1 | | |
| 5020-0241 | Support, long res bd | 28480 | 5020-0241 | 1 | | |
| 5020-0345 | Pin, dowell | 28480 | 5020-0345 | 1 | | |
| 5020-0630 | Hub, dial | 28480 | 5020-0630 | 1 | | |

# See introduction to this section

Table 6-2. Replaceable Parts (Cont'd)

| ℎ𝓅 Stock No. | Description | Mfr. | Mfr. Part No. | TQ | | |
|---|---|---|---|---|---|---|
| 5020-0639 | Bearing, cap drive | 28480 | 5020-0639 | 1 | | |
| 5020-0641 | Shaft, spur gear | 28480 | 5020-0641 | 1 | | |
| 5040-0212 | Insulator, flex coupling | 28480 | 5040-0212 | 1 | | |
| 5040-0607 | Disc ass'y, vernier drive | 28480 | 5040-0607 | 1 | | |
| 5040-0619 | Indicator, freq dial | 28480 | 5040-0619 | 1 | | |
| 5060-0020 | Gear, ass'y with coupling hub | 28480 | 5060-0020 | 1 | | |
| 5060-0021 | Gear, ass'y | 28480 | 5060-0021 | 1 | | |
| 5060-0222 | Handle ass'y, side | 28480 | 5060-0222 | 2 | | |
| 5060-0625 | Ass'y, connector | 28480 | 5060-0625 | 1 | | |
| 5060-0731 | Frame ass'y, 5 x 11 FM | 28480 | 5060-0731 | 2 | | |
| 5060-0739 | Top cover ass'y, 11L FM | 28480 | 5060-0739 | 1 | | |
| 5060-0751 | Bottom cover ass'y, 11L FM | 28480 | 5060-0751 | 1 | | |
| 5060-0766 | Retainer, 5H handle | 28480 | 5060-0766 | 2 | | |
| 5060-0767 | Foot ass'y, FM | 28480 | 5060-0767 | 5 | | |
| 8120-1348 | Cable ass'y, power | | | 1 | | |
| 9100-0293 | Transformer, power | 28480 | 5080-3423 | 1 | | |
| 9140-0029 | Coil, R. F., choke, universal wound, unshielded, 100 μh, 2.6 ohms | 28480 | 9140-0029 | 7 | | |
| 9140-0031 | Coil, R. F., 75 μh | 28480 | 9140-0031 | 1 | | |
| 9140-0037 | Coil, radio freq 5 mh induct, universal wound | 99848 | 35000-15-502 | 5 | | |
| 9140-0041 | Coil, R. F., 2.5 mh ±10% | 95265 | SA-2500-I | 1 | | |
| 9140-0115 | Coil, fxd R. F., 22 μh ±10% | 76493 | 9330-32 | 2 | | |
| 9140-0137 | Coil, fxd R. F., 1000 μh ±5%, dc current rating 135 ma | 76493 | 9220-28 | 4 | | |
| 9140-0230 | Coil, fxd, inductance, 290 μh ±1% | 28480 | 9140-0230 | 1 | | |
| 9140-0231 | Coil, adjustable, inductance, 10.8 to 18.7 μh | 28480 | 9140-0231 | 1 | | |
| 9211-0248 | Carton, corrugated, 20-1/8" lg x 16-3/4" wd x 10-1/2" deep x 350 lb test | 84324 | obd# | 1 | | |
| 9223-0040 | Foam, poly, 10-3/4" lg x 4" wd | 28480 | 9223-0040 | 4 | | |
| 00203-00101 | Chassis, main | 28480 | 00203-00101 | 1 | | |
| 00203-00211 | Panel, front | 28480 | 00203-00211 | 1 | | |
| 00203-00212 | Panel, rear for 115/230v operation only | 28480 | 00203-00212 | 1 | | |
| 00203-00216 | Panel, rear for 100 v operation only | 28480 | 00203-00216 | 1 | | |
| 00203-64201 | Phase shifter | 28480 | 00203-64201 | 1 | | |
| 00203-66501 | Board ass'y, decade module | 28480 | 00203-66501 | 6 | | |
| 00203-66502 | Board ass'y, square wave | 28480 | 00203-66502 | 2 | | |
| 00203-66503 | Board ass'y, 5 mcps | 28480 | 00203-66503 | 1 | | |
| 00203-66504 | Board ass'y, dc amplifier | 28480 | 00203-66504 | 2 | | |
| 00203-66505 | Board ass'y, power supply | 28480 | 00203-66505 | 1 | | |
| 00203-66506 | Board ass'y, R. F. Amplifier | 28480 | 00203-66506 | 1 | | |
| 00203-66507 | Board, ass'y, modulator | 28480 | 00203-66507 | 1 | | |
| 00203-66508 | Board ass'y, V. F. O. | 28480 | 00203-66508 | 1 | | |
| 00203-66510 | Board ass'y, rectifier | 28480 | 00203-66510 | 1 | | |
| 00203-66511 | Board ass'y, filter | 28480 | 00203-66511 | 2 | | |
| 00203-84201 | Transformer, tuned | 28480 | 00203-84201 | 6 | | |
| 00203-84202 | Transformer, tuned | 28480 | 00203-84202 | 6 | | |
| 00203-84203 | Transformer, tuned | 28480 | 00203-84203 | 1 | | |
| 00203-84204 | Transformer, tuned | 28480 | 00203-84204 | 1 | | |
| 00203-84205 | Transformer, tuned | 28480 | 00203-84205 | 1 | | |
| 00203-84206 | Transformer, tuned | 28480 | 00203-84206 | 1 | | |
| 00203-86001 | Coil, var, 2.5 - 6.2 μh | 28480 | 00203-86001 | 6 | | |
| 00203-86002 | Coil, var , 650 - 1100 μh | 28480 | 00203-86002 | 6 | | |

# See introduction to this section

Table 6-2. Replaceable Parts (Cont'd)

| ⓗ Stock No. | Description | Mfr. | Mfr. Part No. | TQ | | |
|---|---|---|---|---|---|---|
| 00203-86003 | Coil, var , 35 - 80 $\mu$h | 28480 | 00203-86003 | 1 | | |
| 00203-86004 | Transformer, driver | 28480 | 00203-86004 | 2 | | |
| 00203-86005 | Transformer, driver | 28480 | 00203-86005 | 2 | | |
| 00203-86006 | Coil, fxd, 4.5 mh | 28480 | 00203-86006 | 6 | | |
| 00203-86009 | Coil, var, 650 - 1100 $\mu$h | 28480 | 00203-86009 | 1 | | |
| 00203-86010 | Coil, var, 35 - 80 $\mu$h | 28480 | 00203-86010 | 1 | | |
| | <u>Additional Parts for 203A Option: 01</u> | | | | | |
| 00203-00213 | Panel, front | 28480 | 00203-00213 | 1 | | |
| 00203-66501 | Board, decade module | 28480 | 00203-66501 | 1 | | |
| | <u>Additional Parts for 203A Option: 02</u> | | | | | |
| 00203-00214 | Panel, front | 28480 | 00203-00214 | 1 | | |
| 00203-66501 | Board, decade module | 28480 | 00203-66501 | 2 | | |

# See introduction to this section

# MANUAL BACKDATING CHANGES

MODEL 203A

VARIABLE PHASE FUNCTION GENERATOR

Manual Serial Prefixed: 1201J-
-hp- Part No. 00203-99002

This manual backdating sheet makes this manual applicable to earlier instruments. Instrument-component values that differ from those in the manual, yet are not listed in the backdating sheet, should be replaced using the part number given in the manual.

| Instrument Serial Prefix | Make Manual Changes |
|---|---|
| 425-00770 and below | 1, 2, 3, 4 |
| 425-00771 to-008865 | 2, 3, 4 |
| 621, 714, 821 | 2, 3, 4, |
| 1019J and below | 3, 4 |

| Instrument Serial Prefix | Make Manual Changes |
|---|---|
| 1201J-02534 and below | 4 |
| | |
| | |
| | |

CHANGE #1

Current Part No. for Transistor A2Q3, A2Q4, A2Q7 and A2Q8 is 1853-0016, 2N3638 and is a recommended replacement for Part No. 1853-0009, 2N274. If either one of these transistors is replaced with the current 2N3638, the other three should also be replaced and inductors L1 and L2 replaced with a 56 ohm resistor, -hp- Part No. 0687-5601.

This recommended change is to improve phase stability at high temperatures.

CHANGE #2

Change: S2 and S3 to HP Part No. 3101-0100 and 3101-0033, respectively (Page 6-10, Table 6-1 and Page 6-15, Table 6-2).
Change: W1 to HP Part No. 8120-0078 (Page 6-10, Table 6-1 and Page 6-16, Table 6-2).

Miscellaneous Parts Change

Change: HP Part No. 1251-2357 (connector, power) to 1251-0148 (Page 6-11, Table 6-1 and Page 6-14, Table 6-2).
Change: HP Part No. 1400-0084 (Body, fuseholder) to 1400-0110 (Page 6-11, Table 6-1 and Page 6-14, Table 6-2).
Add: Nut, retaining for 1400-0110, HP Part No. 1400-0111 (Page 6-11, Table 6-1 and Page 6-14, Table 6-2).
Add: Knob, fuseholder black for 1400-0110, HP Part No. 1400-0210 (Page 6-11, Table 6-1 and Page 6-14, Table 6-2).
Change: HP Part No. 00203-00211 (Panel, front) to 00203-00201 (Page 6-11, Table 6-1 and Page 6-16, Table 6-2).
Change: HP Part No. 00203-00212 (Panel, rear) to 00203-00202 (Page 6-11, Table 6-1 and Page 6-16, Table 6-2).
Change: HP Part No. 00203-00213 (Panel, front) to 00203-00203 (Page 6-11, Table 6-1 and Page 6-17, Table 6-2).
Change: HP Part No. 00203-00214 (Panel, front) to 00203-00204 (Page 6-11, Table 6-1 and Page 6-17, Table 6-2).

Delete C4 C5 and thru C10
Add C4 A, B 0150-0119 C: fxd, cer, 2 x 0.1 $\mu$f ±20%, 250vdcw
Add C5 thrn C10 Not assigned

CHANGE #3

Change: HP Part No. 5000-8597 (Side Cover) to 5000-0732 (Page 6-15, Table 6-2).
Change: HP Part No. 5000-8599 (Side Cover) to 5000-0733 (Page 6-15, Table 6-2).
Change: HP Part No. 5060-8587 (Top Cover Ass'y) to 5060--0739 (Page 6-16, Table 6-2).
Change: HP Part No. 5060-8711 (Bottom Cover Ass'y) to 5060-0751 (Page 6-16, Table 6-2).
Change: HP Part No. 5060-8737 (Retainer) to 5060-0766 (Page 6-16, Table 6-2).
Change: HP Part No. 8120-1378 (Power Cord) to 8120-1348 (Page 6-16, Table 6-2).
Change: HP Part No. 00203-00311 (Front Panel) to 00203-00211 (Page 6-16, Table 6-2).
Change: HP Part No. 00203-00313 (Front Panel for OPT 001) to 00203-00213 (Page 6-16, Table 6-2).
Change: HP Part No. 00203-00314 (Front Panel for OPT 002) to 00203-00214 (Page 6-16, Table 6-2).

CHANGE #4

Change: HP Part No. 0160-0378 (C12) to 0140-0145 (Page 6-10, Table 6-1 and Page 5-21, Figure 5-14).